

THE  
Psychological Review

EDITED BY

J. MARK BALDWIN

JOHNS HOPKINS UNIVERSITY

AND

HOWARD C. WARREN

PRINCETON UNIVERSITY

CHARLES H. JUDD, Yale University (*Editor Psychological Monographs*).

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THE REVIEW PUBLISHING CO.,  
41 NORTH QUEEN ST., LANCASTER, PA.  
AND BALTIMORE, MD.

AGENTS: G. E. STECHERT & CO., London (4 Star Yard, Carey St., W. C.);  
LEIPZIG (Hospital St., 10); PARIS (75 rue de Rennes);  
MARRIUS, D. JORISO (Calle de la Paz, 21).

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THE PSYCHOLOGICAL REVIEW, New Series, is issued in two sections; the REVIEW proper, containing original contributions, appears bimonthly, on the first of January, March, May, July, September, November, the six numbers comprising a volume of at least 400 pages; the LITERARY SECTION (PSYCHOLOGICAL BULLETIN) containing critical reviews, notices of books and articles, Psychological news and notes, university notices, announcements, and shorter discussions, appears the fifteenth of each month, and forms a separate volume of at least 300 pages.

**Annual Subscription to Both Sections, \$4.00, Canada \$4.15 (Postal Union, \$4.30); Bulletin Alone, \$2.00, Canada, \$2.10 (Postal Union, \$2.20); Single Numbers of The Review, 50c. (53c.); of Bulletin, 25c. (27c.).**

## THE PSYCHOLOGICAL INDEX

a bibliography of books, monographs, and articles upon psychological and cognate topics that have appeared during the year. The *Index* is issued in April, and may be subscribed for in connection with THE REVIEW, or purchased separately. *Index* and REVIEW, \$4.75 per annum (postage 10 cents); Canada, \$4.90 (postage 10 cents); Postal Union, \$5.05 (postage 10 cents). *Index* alone, \$1.00.

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The price of single numbers varies according to their size. Eight volumes have been issued of the Psychological Monographs and the first volume of the Philosophical Monographs is in progress.

Subscriptions, orders, and business communications may be sent direct to the Business Manager of the PSYCHOLOGICAL REVIEW, Johns Hopkins University, Baltimore, Md., or forwarded through the publishers or agents.

PUBLISHED BY

THE REVIEW PUBLISHING CO.,  
41 NORTH QUEEN ST., LANCASTER, PA.  
AND BALTIMORE, MD.

AGENTS: G. E. STECHERT & CO., LONDON (2 Star Yard, Carey St., W. C.);  
LEIPZIG (Hospital St., 38); PARIS (76 rue de Rennes);  
MADRID, D. JORRO (Calle de la Paz, 21).

# THE PSYCHOLOGICAL REVIEW.

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## STUDIES IN ÆSTHETIC VALUE.

BY PROFESSOR H. HEATH BAWDEN.

### ARTICLE II.

#### THE NATURE OF ÆSTHETIC EMOTION; WITH A CRITIQUE OF MISS PUFFER'S THEORY OF STIMULATION AND REPOSE.

We have dwelt upon the immediacy of the æsthetic consciousness in our consideration of the nature of value. We there discovered that one of the distinguishing marks of the value experience is its strongly affective and conative character. In the present discussion we must come to close quarters with the meaning of the statement that the æsthetic experience is predominantly emotional in character.

In the first place, it must be recognized that æsthetic emotion, like all feeling, is directly connected with the functioning, or with the inhibition of the functioning, of those deep-seated conative tendencies of the organism called instincts and habits. These instincts have been inherited from our animal ancestors, in some instances with but slight modification, in other cases with large modifications by the grafting upon them of acquired traits. There is usually a large increment of habits built up in the lifetime of the individual which, in the case of man, particularly, give the peculiar or characteristic turn which the emotions take in the particular person.

Emotions, in other words, are connected organically with the latent vestiges of originally useful facts. Fear, anger, shame, surprise, joy, grief, each has its characteristic emotional expression which is, for the most part, an involuntary and often unconscious change in both the hidden and overt activities of the organism. In general, instinctive action tends to be automatic when it functions in a free and unimpeded manner.

Feeling and emotion emerge when such function is obstructed or inhibited for any reason. Instinct then becomes impulse which on the conscious side is known as feeling.

The emotional reaction is an impulsive reaction. It differs from the instinctive reaction in being a vaguely total conscious response to the situation rather than a definitely accurate automatic response. It is on this account likewise that emotion is the bearer of the value consciousness. It comes to us in terms of that vague background of unanalyzed and unlocalized organic and tactile-kinæsthetic sensations which, while inarticulate as knowledge, are of supreme importance in constituting that core of psychophysical identity known as the empirical ego.

Without going into a discussion of conflicting theories of the nature and conditions of pleasure and pain, the theory may here be stated which seems to explain most of the facts. It was first formulated by the late Professor C. L. Herrick,<sup>1</sup> who named it the 'summation-irradiation' theory from the two processes which are the fundamental conditions of the feeling consciousness.

#### 6. *The Summation-Irradiation Theory.*

Aristotle long ago defined pleasure as the perfect energizing of sense by its appropriate object, and modern writers have only re-phrased his doctrine when they connect pleasure with organic activity lying between the extremes of excessive and deficient stimulation. Pleasure, it is affirmed, is connected with the anabolic, constructive, building-up process; pain, with the katabolic, destructive, tearing-down process. Thwarting a habit is painful. Exploiting a habit is pleasurable. Encountering resistance is pleasurable only if it results in the final triumph of a habit. Or, as Dr. Marshall puts it, pleasure and pain are determined by the relation between the energy expended and the energy received at any given moment by the physical organs which determine the content of the moment. That is, pleasure is experienced whenever a surplus of stored energy is discharged in the reaction to the stimulus; pain whenever a stimulus claims

<sup>1</sup>Cf. *Supplement to Wood's Reference Handbook of the Medical Sciences*, Vol. IX., 1893, p. 270 f., and *Journal of Comparative Neurology*, Vol. V., p. 18 f. (March, 1895), and Vol. VII., p. 155 f. (March, 1898).

a greater development of energy than the organ is capable of affording.

Reformulating these ideas, Professor Herrick's theory holds that the conditions of pleasurable feeling are irradiation (1) along lines of habitual response (2) of stimuli whose summation and discharge fall within the limits of the normal functioning of the organ or organs involved. Such reactions as laughing, sneezing, tickling, itching, inflammation illustrate this twofold principle. As long as these processes fall well within the limits of normal habit, they are not painful and may be positively pleasurable. But let the summation exceed these limits in the case of any one of them and it becomes painful. Thus one may laugh till he cries. Sneezing which ordinarily is accompanied by a pleasant feeling of relief may become painful. Tickling readily passes the limit of pleasure. Itching is pleasurable only when the stimulus is diffused as by rubbing or scratching the part. And the pleasurable glow of local hyperæmia soon passes over into the painful processes of pathological inflammation.

The mechanism of irradiation in the case of the higher pleasures such as those of the æsthetic consciousness is to be found in those elaborate habits of attention described in the psychology-books under the rubrics of association of ideas, apperceptive systems, psychical dispositions, etc. These intellectual habits all have a physiological basis, of course, differing from the recognized sense-habits only in the remoteness and subtlety of their operation. Professor Herrick finds the mechanism for irradiation, in the case of the higher emotions, in the associative centers of the cortex with its myriad paths and intricate meshwork of conduction-pathways, corresponding to the complex ramification and the terminal arborizations of the nerves in the erectile tissues of the body in the case of the more intense of the sense pleasures. But doubtless it is inaccurate to connect the intellectual pleasures exclusively with the switch-board connections in the cortex; they, too, ultimately, involve vascular and other metabolic changes in the peripheral sensory and motor apparatus. Just what these peripheral changes are in the case of the higher emotions it is difficult to specify with certainty in the present state of our knowledge, but that the most abstract intel-

lectual processes involve peripheral sensory-motor adjustments no physiologist now doubts. It is simply a question of detailed investigation which students of physiology and psychology are bound in time to solve. Indeed, the question is already beginning to be solved by the studies which are now being pursued into the phenomena of motor control, voluntary attention, the physiological conditions of emotion, movement-sensations, and so-called imageless thought.

The emotions then, are like the sympathetic vibrations of a musical instrument. If there is a conflict of vibrations, dissonance, pain, results. If there is reinforcement of the fundamental (habit) by overtones, by connected systems (other habits), we have harmony or pleasure. In the case of æsthetic emotion there is the maximum of stimulation compatible with a final reinforcement by the corresponding intellectual habits or apperceptive systems.

Stimuli are experienced as pleasurable in proportion as they relieve existing strain or overcome resistance and give control, in each case the pleasure being due to the fact that relief and control represent the reorganization of the experience in terms of fundamental instincts and habits of the organism. Discharge, expression, irradiation of the energies of the organism within certain limits, *i. e.*, relaxation and favorable stimulation are pleasurable; because they take place along the familiar and easy paths, the line of least resistance, of habitual response. Stimuli are experienced as painful in proportion as they fail to relieve such strain or to overcome such resistance, *i. e.*, when the summation of stimuli or inhibition of impulses reaches a point beyond the capacity of the irradiative controlling apparatus of habit to cope with it.

In other words, stated as a general principle, with the limitations just noted, it may be said that pain means congestion, contraction, obstruction, disadaptation, a 'disproportionateness of stimulus to the conveying power of the organ.' Pleasure means diffusion, expansion, irradiation, discharge. In both cases there is summation of stimuli, inhibition and conflict of impulses, but in the case of pain this summation finds no overflow or the process of inhibition is carried to the point where the subsequent

discharge results in a further mal-adjustment because it exceeds the normal irradiative capacity of the habits involved.

Fear and grief are good illustrations of summation which becomes painful. The sudden transformations of wit and humor illustrate the principle of irradiation. When we seek to divert the attention of the hurt child or take a trip to Europe to escape the torture of a consuming sorrow, we are unconsciously employing this principle: we seek a normal irradiation for the congested stimuli and impulses by calling into play a different set of habits, a greater variety and range of apperceptive systems. Why is rest after hard work pleasant? Whence the glow of pleasure which accompanies the consciousness of success even when one is fatigued? It comes from the fact that the energies which have been with effort directed along less accustomed lines are suddenly released into the more habitual channels of familiar and easy response. Pleasure is connected with moderate stimulation, with the normal functioning of organs. But it must be remembered, that what is moderate and normal varies with different conditions. Tension is the condition of consciousness everywhere, but this tension is *relative* to the situation and to the needs of the organism.

#### 7. *The Relativity Doctrine.*

There are two sets of facts in apparent opposition to this law of pleasurable emotion, which must be considered if this law is to become an accredited principle of æsthetics. In the first place, there are all the facts of the relativity of pleasure and pain. What is painful to one person may be only agreeably stimulating to another, and the same is true for a given individual under different conditions of health, nervous irritability and fatigue. In other words, summation or irradiation is painful or pleasurable only under certain conditions of intensity; it is relative to the existing state of tension or equilibrium in the organism. If pleasure meant merely ease of adjustment, habit should carry with it the greatest pleasure and pain should be in direct ratio to difficulty of adjustment, neither of which is uniformly the case. Up to the limit of normal functioning only, does pleasure increase with summation and subsequent irradiation.

tion; beyond this point pain supervenes. What this limit is, in the particular case, is determined by all sorts of conditions, hereditary and environmental, permanent and transitory. So that while the general principle holds, that when summation and irradiation lie between certain limits of intensity normal to the individual organism it is pleasurable, yet these limits are a sliding scale even in the experience of the individual, and of course much more so in the comparison of different individuals.

Within certain limits summation, inhibition, stimulation, tension, antagonism of impulses, serves only to heighten and enhance the pleasure, and conversely beyond certain limits irradiation, discharge, diffusion of response, expression of impulses tends to weaken the pleasurable emotion.

This relativity doctrine perhaps explains why it is that we seem able actually to take pleasure in certain painful experiences, such as tragedy, the emotions of pity and fear, and what has been called 'the enjoyment of pain.' All excitement, up to a certain point, tends to be pleasurable. Hirn<sup>1</sup> speaks of the stimulating effect of acute pain, of a heightened sense of life due to mental suffering, of "a yearning after increased consciousness, which leads us to pursue, even at the risk of some passing pain, all feelings and emotions by which our sensation of life is reinforced and intensified" (p. 37), and cites the self-woundings of the saints and orgiastic self-lacerations of the Bacchanalian phrenzy in evidence.

The truth is that, as Miss Puffer says, these pains which we enjoy are not really like the pains of real life, since they leave us in control of the situation; the situation is finally resolved along the line of some habit-system, whereas the genuine sufferings of actual life remain unresolved; the breach in the habit-system is not healed over. For this reason we must assume that æsthetic emotion is always and necessarily pleasurable. A work of art must please, no matter how repellant the subject. Even in case of tragedy and the ugly in art and this so-called enjoyment of pain, there must be a preponderance of pleasurable emotion or the object or situation does not fall within the æsthetic sphere.

<sup>1</sup> *Origins of Art*, Chapter V

In the second place, it is recognized that while within certain limits expression enhances pleasure, it is also true that beyond certain limits this same expression diminishes the pleasure. The explanation is simple: The irradiation of the stimulus to wider areas and neighboring organs results in a greater diversification and intensification of the stimulus, calls into play a richer background of apperceptive habit-systems. What is thus called the initial expression of the emotion viewed from the outside is really a continuation of the summative process of rolling up the stimulus until it has called into operation the widest range of relevant reaction-systems. The extent to which this irradiation or so-called expression of the emotion serves thus to enrich rather than to reduce its pleasant quality is determined by the resources of latent or stored energy in the individual which is capable of being released by this overflow to adjoining areas. Only within such limits is it true that "pleasure feeds and nurtures itself by expression."<sup>1</sup>

On the same principle it is true that pain grows deeper and more wide-spread if and to the degree that it progressively implicates adjoining areas and organs so that these too become 'tied up' in the total inhibitory process. It is a commonplace that pain is at its keenest when the outward expression is at its lowest, but it is equally well recognized that pain often stimulates intellectual activity. This is true, however, only as long as it does not pass beyond a certain degree of intensity, and is due to the fact that in the attempted readjustment, a part of the inhibited energy is directed into relatively unused channels. This is the explanation of the so-called chance hits or extraordinary insights—more properly described as the unexpected relevancies—of genius. And just as the extreme of expression reduces pleasure, so, at last, inhibition, if it leads to immobility and depletion of the vital forces, leads to the reduction of pain, resulting in a comatose euthanasia.

It is not an accurate analysis which distinguishes two kinds of pleasure: one in which the satisfaction springs out of habitual, customary easy lines of activity; and another the satisfaction which springs from following fresh stimulating,

<sup>1</sup> Hirn, p. 41.

novel lines of activity, with their potential possibilities of success. The same principle holds for both. Just as it is not habit as such, so it is not stimulation as such, which gives pleasure: it is the relation or proportion between these. The 'novel' element liberates and exercises deeply ingrained instincts and habits whose function within normal limits is pleasurable. It is the relative freeing of these habits by the novel element and their tensional functioning within these limits which constitutes the pleasure.

#### 8. *Æsthetic Pleasure.*

But while all æsthetic experiences are pleasurable, not all pleasures are æsthetic. What, then, as Dr. Marshall asks,<sup>1</sup> 'are the bounds of the æsthetic within the hedonic field'? His answer to the question is that "that object is to be considered beautiful which produces a psychosis that is permanently pleasurable in revival . . . and that object is to be considered ugly which produces a psychosis that is permanently disagreeable in revival" (p. 110). Only the permanently pleasurable can be æsthetic. Pleasures are characteristically fleeting. They are not classified as æsthetic unless they last, unless they are revivable. Many pleasures which are pleasant while they last are not pleasant in revival, *e. g.*, the pleasures of the so-called lower senses. "For each person the æsthetic field to which he refers in making judgments as to beauty is his relatively permanent pleasure-field of revival" (pp. 152, 153).

"The artist," he goes on to say, "must employ all possible means leading to the attainment of immediate pleasures so far as these are compatible with the production of pleasures in revival. He may add much in the way of mere presentative pleasure which perhaps may not bring us pleasurable effect in revival; and all such added pleasure in presentation is a gain to the work as art, provided it neither bring pain in revival nor swamp with resulting indifference the revivals that are pleasant. He may even go further, and add elements which give decided active painfulness in the direct presentation produced by the examina-

<sup>1</sup> *Pain, Pleasure and Æsthetic*, p. 125.

tion of the art work, provided the result in revival be on this account made more permanently pleasurable."<sup>1</sup>

There are two prerequisites, he says, of producing pleasure-permanency: The first is width of field. The artist groups together as large a number of means of pleasure stimulation as he can combine without conflict. This gives the context, background, system, a variety unified into a totality (cf. pp. 173, 174). The second is a shifting focus. This gives the definite object in the foreground, a center to the system. As Lotze and Volkmann insist, "beauty requires the grasp of the ideal through some definite object." Variety must be particularized in individual objects.

"In general, therefore, we may say that the conditions of pleasure-permanence are the shifting of the focus in consciousness over a wide pleasure-field" (p. 173). This shifting may be regularly recurrent; and this gives us the great principle of rhythm. In accordance with this principle Dr. Marshall says that the arts of literature and music are of preëminent importance because they involve the stimulation of successive mental states and thus a shifting of points of interest over wider fields than in the case of the other arts (cf. pp. 188, 189).

"On the whole, it appears that the safest means of producing lasting æsthetic results will be reached if we choose that succession of elements, each of which is naturally led up to by those which have preceded; or to put this in psychological language, we will gain our best result if we choose such successive impressions as will stimulate organs that have been best and fully prepared for action by the associative nutrition (if I so may speak) connected with the previously stimulated activities." This he calls the principle of the satisfaction of expectancies (pp. 185, 186). This principle will explain the function of the dominant lines and figures in composition, the combination and harmony of colors, the rôle of rhythm in music, poetry, and the dance, the significance of symmetry, proportion, balance in plastic art, the use of plot in fiction, etc., these forms representing the objective equivalents of habit systems which fall within the limits of pleasurable functioning. But this leads

<sup>1</sup> *Æsthetic Principles*, pp. 115, 116; cf. 127, 189.

us to the whole problem of the cognitive element in the æsthetic consciousness; the imagery necessary to give the basis and framework of permanency to these otherwise fleeting emotional experiences, which must await a subsequent occasion for fuller consideration.

#### 9. *Stimulation and Repose.*

Assuming for the present that the æsthetic consciousness is always pleasurable, our conclusions as to the nature of æsthetic value have prepared us for a statement of the general law of the æsthetic consciousness: the maximum of intellectual meditation compatible with its remaining a pleasurable value experience, or in other terms, the maximum of stimulation compatible with repose. The implications of this law may be brought out by a critique of Miss Puffer's theory of the æsthetic repose in Chapters II. and III. of her *Psychology of Beauty*.

We have seen that, according to Miss Puffer, instead of grounding the definition of beauty in the empirical investigations of psychology, these investigations are to be squared up with the 'imperative of beauty' (preface, p. vi). In the chapters to which we now turn, Miss Puffer characterizes æsthetic feeling as 'a combination of favorable stimulation and repose' (p. 50). "The diffusion of stimulation, the equilibrium of impulses, life-enhancement through repose; this is the æsthetic experience" (p. 55). It is 'the union of repose with activity' (p. 50). "Æsthetic emotion . . . consists just in the union of a kind of stimulation or enhanced life, with repose; a heightening of the vital energies unaccompanied by any tendency to movement, in short, that gathering of forces which we connect with action, and which is felt the more because action is checked" (p. 244).

Let us examine this conception. Miss Puffer starts out by distinguishing between a state of unity which is static, mere congealment or emptiness without tendency to change (p. 49), and a state of unity which is the result of the balance of antagonistic impulses and therefore dynamic. In the latter instance the organism is 'at the highest possible point of tone, of functional efficiency, of enhanced life' (p. 50). The latter alone is the condition of æsthetic repose. Repose does not mean immobility but the balancing of opposed forces; it is a dynamic equilibrium —

the basis of that unity in variety, that proportion, harmony and symmetry of form which have always been regarded as essential to beauty.

Thus far all is clear. The æsthetic repose is a dynamic and not a merely static equilibrium. But note, now, the terms in which this dynamic repose is described. She elsewhere recognizes that stimulation and repose are contradictory concepts, but here maintains that in the æsthetic experience "the stimulation resulting in impulse to movement or action is checked or compensated for by its antagonistic impulse" (p. 50). The effect (in the immediate context of the passage just quoted) she describes as the 'inhibition of action, or action returning upon itself, combined with heightening of tone.' "The perfect equilibrium, that is equilibrium with heightened tone, will then give the perfect moment" (p. 51).

#### 10. '*Repose in Excitement.*'

In another place (p. 207), she says: "The end of beauty is always the same, the perfect moment of unity and self-completeness, of *repose in excitement.*" The words which we have italicized express the truth of her theory better, if anything, than her more formal statement which combines 'favorable stimulation and repose' (p. 50), in which, if our analysis be correct, there is a redundancy in the use of the two words 'favorable' and 'repose.'

On p. 52 she writes: "The positive toning of the experience . . . is due not only to the favorable stimulation, but also to the fact that the very antagonism of impulses which constitutes repose heightens tone while it inhibits action. Thus the conditions of both factors of æsthetic emotion tend to produce pleasure." Now, we would inquire, Is it the 'antagonism' of impulses which produces repose or is it the 'favorable' character of the stimulation? She attributes the repose to the antagonism: 'the very antagonism of impulses which constitutes repose.' Is not the effect of the antagonism of impulses to intensify, to heighten the tone, to use her phrase, rather than to produce a state of repose? Is not this the law of consciousness everywhere: that change, tension, conflict, antagonism of impulses,

is the condition of consciousness? This 'antagonism of impulses' is really a description of the consciousness which the stimulation calls out; it defines the character of the particular stimulation in question; it is one which produces such and such conscious conflict. On p. 285, she describes æsthetic pleasure as a physiological equilibrium, a 'coexistence of opposing impulses which heightens the sense of being while it prevents action.' The truth is that the coexistence of opposing impulses 'heightens the sense of being' *because* it prevents action; it is the inhibition of overt action which produces the inward excitement known as consciousness.

The element of repose is to be connected not with the fact of the antagonism of impulses, but with the 'favorable' character of the stimulation. And Miss Puffer virtually admits this in certain passages where she approximates a definition of what she means by this phrase. In her chapter on 'The Beauty of Fine Art,' speaking of the beauty of the serpentine line as 'leading the eye a kind of chase,' as Hogarth says, she says that "sharp, broken, starting lines might be the basis of a much more vivid experience, but it would be æsthetically negative. 'The complete sensuous experience of the spatial' is not enough, unless that experience is positively, that is, favorably toned. Clear and vivid seeing made possible by the form of the object is not enough. Only as *favorably* stimulating, that is, only as calling up ideal reproductions, or physical imitations, of movements which in themselves were suited to the functions of the organs involved, can forms be found positively æsthetic, that is, beautiful" (p. 104). "Whatever in sense stimulation gives the condition for, helps, furthers, enhances the natural function, is felt both as pleasing and as furthering the particular activity in question" (p. 163).

Now note, the 'ideal reproductions or physical imitations' are not called up because the stimulation is *favorable*; they are called up by the bare fact of the *stimulation*: ideal reproductions and imitative responses would be called up if the stimulation were unfavorable, and perhaps to a greater extent. The favorable character of the stimulation is found in the fact that the movements which are thus ideally reproduced or physically

imitated are 'suited to the functions of the organs involved,' *i. e.*, falls within the normal limits of their functioning, *i. e.*, are habitual, and therefore familiar and smooth and easy, and therefore pleasurable. This is the true explanation of the element of repose in the æsthetic experience; it is found in the favorable character of the stimulation, not in the antagonism of impulses which accompanies the stimulation.

"Let us consider once more the concept of equilibrium," says Miss Puffer. "Inhibition of action through antagonistic impulses, or action returning upon itself, we have defined it" (p. 55). Commenting on Guyau's 'famous drink of milk among mountain scenes,' which she explains by a swift consciousness of 'general stimulation,' she says that "this diffused stimulation is likely to come from such exercise as is characterized by the mutual checking of antagonistic impulses producing an equilibrium. The diffusion of stimulation would be our formula for the æsthetic state only if interpreted as stimulation arresting action" (p. 55). "The diffusion of stimulation, the equilibrium' of impulses, life-enhancement, through repose!—this is the æsthetic experience" (p. 55.)

Let us look into this. The 'diffusion of the stimulation' certainly results from the mutual checking of impulses, but the immediate result of such 'mutual checking' is not equilibrium; it is rather the disturbance of equilibrium, since impulses are seldom or never exact equivalents. It is the manner of the 'diffusion' rather than the fact of the arresting of action that produces the state of equilibrium or repose. It is the fact that the inhibited stimulation diffuses along habitual lines, *i. e.*, becomes a favorable stimulation, which produces the pleasurable reposeful state.

There is no desire on the part of the present writer to beat at a man of straw of his own fabrication; the aim throughout has been a truly immanent criticism. But he has been unable to escape the conclusion, from a careful comparison of different passages in Miss Puffer's book, that there is a real contradiction, or at least a confusion, of issues.

In her chapter on 'The Beauty of Music' she says, "Rhythm is undoubtedly favorable stimulation," and she explains this by saying that "expectation is the 'set' of the

attention. Automatism is the set of the motor centers. Now, as attention is parallel to the condition of the motor centers, we are able to equate expectation and automatic movement. Rhythm is literally embodied expectation, fulfilled" (p. 165). A rhythm once established has both retrospective and prospective reference. "It looks before and after, it binds together the first and the last moments of activity, and can therefore truly be said to return upon itself, so as to give a sense of equilibrium and repose" (p. 166).

Here we have an unmistakable description of the basis of the repose of rhythm in the facts of automatism and habit. The repose of rhythm is due to favorable stimulation, not to antagonism of impulses. She goes on, of course, to show that this element of antagonism is not wholly absent from rhythm; it is indeed essential, being represented in the variation, alternation, syncopation, accent, etc. But if this is its office, it can scarcely at the same time be said to be the factor which is responsible for the pleasurable sense of repose.

Once again, in the latter part of this same chapter on music, she says that everything has gone to show that music possesses to the very highest degree the power of stimulation. Can we attribute to it repose in any other sense than that of satisfying a desire that it arouses? We can do so, she says, "in pointing out that music ever returns upon itself—that its motion is cyclic. The æsthetic emotion for music is then the favorable stimulation of the sense of hearing and those other senses that are bound up with it, together with the repose of perfect unity" (pp. 200, 201).

Here we have the same confusion of the two factors. Surely a cyclic motion, one that returns upon itself, is an habitual reaction, and to the extent that the fact of repose rests upon such facts, it can scarcely be due to antagonism of impulses. And it is the favorable character of the stimulation, the fact that the stimulation falls well within the limits of such cyclic or habitual organic response, that makes the experience reposeful. What gives music its heightened tone is the relatively large amount and range of impulses which it is capable of exploiting while yet remaining a pleasurable reposeful experience.

## II. 'Confrontation.'

Miss Puffer's theory of the drama is a test of her principle. She agrees with most writers that conflict is an essential element in the drama, whether tragedy or comedy. The tragic, springing doubtless from the fundamental fighting instinct in man, and the comic, springing it seems from the sense of superiority — both of these imply the encountering and the overcoming of obstacles. "Every drama must be the artistic presentation of a conflict," says Shaw.<sup>1</sup> "The end may be reconciliation or destruction, or, as in life itself, there may be no end; but the conflict is indispensable; no conflict, no drama."

But, as in the case of the general theory of the æsthetic repose, so here she seeks to interpret the conflict or 'confrontation,' as she calls it, in terms of the emotional rather than in terms of intellectual process. She starts out with the perfectly sound statement of the principle, that the æsthetic experience "consists just in the union of a kind of stimulation or enhanced life, with repose" (p. 244), but then goes on to say that the peculiar characteristics of the drama is 'the face to face confrontation of forces.' 'Confrontation, and not action' is the dramatic principle. The dramatic conflict is an 'equilibrium of impulses' (p. 244); 'a balance of emotions' (p. 245); it is an "æsthetic 'arrest,'" a 'tension of confrontations' (p. 257).

We encounter here the same confusion as in her general theory of æsthetic emotion. Is it the confrontation or the equilibrium and repose which constitutes the drama a pleasurable emotional experience? It scarcely may be both, since the condition of pleasurable emotion is irradiation after summation within such limits of habit functioning as to produce a sense of control. Confrontation as such, antagonism of impulses, makes directly against equilibrium, not for it. It is the intellectual element, the element of diversity, in the æsthetic experience, not the emotional element, the principle of unity. This is obvious from the effect of confrontations in the tragedies of real life. The true statement of her principle would be that the enjoyment of tragedy is due to the *relatively high degree of summation*, tension, conflict, balancing of antagonistic move-

<sup>1</sup> *Plays Pleasant and Unpleasant*, II., p. vii.

ments and situations, *combined with irradiation along habitual lines*. The discharge takes place along general lines, general diffusion through avenues or motor organs which would be involved in an actual tragedy. The rhythm and the meter, as Wordsworth says, give the pleasure, and only thus are we able to endure the painful content.<sup>1</sup> Miss Puffer does not recognize the necessity of a mechanism of irradiation or alleviating discharge to keep the spectator's contemplative attitude from passing into one of real tragedy. Her only suggestion of such a necessity is found in her discussion of 'the illusion of the triumphant will' (p. 251).

Miss Puffer therefore is on the wrong track when she regards the 'confrontation of forces' as furnishing the peculiar conditions of the emotion of tragedy and of the mysterious katharsis (p. 244). Instead of 'the peculiar katharsis, or pleasurable disappearance or alleviation of emotion in tragedy' being based on the element of confrontation, it is based rather on the retention of this open channel of irradiation represented by what she calls the conscious self-illusion of the theater-setting. The confrontation of forces is the condition of the intellectual character, the enhancement of life, the stimulating character of the drama, not of its pleasurable emotional character.

Confrontation is not a 'balance of emotions' (p. 245), but the balance of emotions means the beginning of ideas, and this gives rise to the fact of confrontation. Tension, conflict (her word 'balance' here is unhappy) arises when the more immediate habitual and emotional types of reaction come into conflict — and such conflict calls out images and ideas. Instead of its being true that "two opposed movements cannot take place at the same time" (p. 243), this conflict of nascent movements is just what constitutes an idea. It is impossible to have two opposed emotions, but it is quite possible, she says, for ideas to 'dwell together in amity' (p. 243). But just to the extent that ideas do thus dwell together in amity, they cease to be ideas and become habits: ideas exist only as long as conflict or confrontation or antagonism of impulses lasts. Amity is the one

<sup>1</sup> Preface to the second edition of his poems. Houghton, Mifflin & Co.'s edition, 1904, p. 786.

character that ideas, as such, never present. When "the spectator has a vivid picture of Othello and Desdemona together" his emotions are not properly described as having 'neutralized each other' or as 'in abeyance': they have passed into the phase of ideas.

Nor would it be true, if our criticism is pertinent, that "the unity given by the confrontation and tension of simultaneous forces belongs to the drama alone" (pp. 250, 251). In the first place, as we have seen, the confrontation introduces diversity, not unity, into the æsthetic experience of the drama and is thus, in the second place, only a striking example of the principle of stimulation or diversification which runs throughout all æsthetic experiences. The æsthetic 'arrest' (p. 257) and what she calls the 'unique independent emotion of tension' (p. 259) is the principle of diversification, not the principle of unity and repose.

The whole matter may be summed up in the following way: The context or setting of the theatre (the stage, footlights, darkened room, sitting at ease, etc.), all predetermines that the experience is to be a pleasurable one emotionally: there is, if you like, a conscious self-illusion which means that certain channels of irradiation, certain physiological overflows, are kept open to drain off the effects of the excess stimulation in case of the portrayal of scenes calculated to arouse painful emotions. Within the limits of this predetermined 'set' of the organism the drama then proceeds to exploit certain primitive deep-seated instincts and habits whose stimulation and summative discharge within the aforesaid limits yield pleasure—and yield the greater pleasure the more intense and diversified the stimulation compatible with its not passing the limit thus set. Duels, murders, intrigues, plots, revenges, escapades, adventures, in a word the appeal to pity, fear and love—these all vicariously function such modes of activity as once were seriously significant in the phylum. The finer deploying of the more delicate types of social and intellectual adjustment represented by the problem play and, for example, by Henry James' novels, only illustrate the principle in its more subtle application. This functioning of older and more familiar habits of response, whether it be in witnessing the survival of the primitive scrimmage of savages

at a football game or following the complicated motivation of what Mr. James calls a 'relation' in one of his novels — it is this which even in the case of tragedy, makes the experience an emotionally pleasurable one. In both the tragedy and the comedy the spectator must be left in control of the situation; in the latter case by the inner logic of the drama as well as by the illusionistic psychological 'set' of the organism; in the former case the control element residing exclusively in this latter factor. There is no reason why one should not weep at a tragedy as well as laugh at a comedy.

#### 12. *Katharsis and the Conscious Self-Illusion Theory.*

A correct understanding of the law of stimulation and repose makes intelligible two doctrines which have long been the subject of controversy in æsthetic theory — the Aristotelian Katharsis, and the Conscious Self-Illusion Theory.

Aristotle's theory of katharsis was an attempt to explain how it is possible in such æsthetic experiences as the tragedy to 'take pleasure in painful experiences.' Miss Puffer rejects Aristotle's view that every emotion, be it ever so painful, contains an ecstatic, and hence a pleasurable element. "Pity and fear are never anything but painful down to the vanishing point," she says. "Pity and fear do not in themselves produce pleasure, relief and repose" (pp. 236, 237). "It does not give us pleasure to have painful emotions or to see other people's sorrow." "If we feel pleasure, excitement, elevation in the representation of the tragic, it must be due to some other element in the experience than the mere self-realization involved in suffering." "For the immediately pleasurable æsthetic effect of tragedy, a certain kind of pity and fear, operating in a special way, are required" (p. 239). There must be 'an entirely new element.'

This 'new element' which transforms the painful pity and fear of real life into the pleasurable emotions implied in the enjoyment of the drama, Miss Puffer finds in the 'peculiar character of the emotions aroused' (p. 239). She asks two questions: (1) "How can we feel any emotion at all in watching what we know to be unreal," and (2) "why do we feel *with*, rather than toward or about, the actors?"

Certain writers insist that the essence of art is to give the illusion of reality, which means that it must call into operation the deepest-lying habits of our nature in an emotional experience. Others hold that there is always a conscious self-illusion, that the spectator never really forgets that the artistic representation is not the actuality. The distinction between the emotions aroused in the æsthetic experience of tragedy, Miss Puffer says, lies in the fact that in the drama those emotional responses are inhibited which in real life would be directed toward the actors in scene. In lieu of an emotional attitude taken by the spectator *toward* the actors there is substituted an emotional attitude sympathetic *with* that of the actors in the play. The emotions are sympathetic or imitative instead of having an objective reference. "The artificial conditions of the spectator at a play, which reinforce the vivid reproduction of ideas, and check action, stifle those emotions directed toward the players" (p. 240). "The depth of æsthetic feeling lies not in the worthy countryman who interrupts the play with cries for justice on the villain, but in him who creates the drama again with the poet, who lives over again in himself each of the thrills of emotion passing before him, and loses himself in their web." "The complex of the ideas and associations of the persons of the play is ideally reproduced" (p. 242), says Miss Puffer, as well as the 'emotional movements of the actors.' "Are not the organic reactions belonging to these set up too? — not directly, in response to a situation in which the spectator may act, but indirectly, by reproduction of the mental contents of one who may act, the person of the drama? The final answer to this question contains," she says, "the whole kernel of the dramatic mystery, and the starting-point for an æsthetic theory of tragedy" (p. 242).

A correct interpretation at this point clears up the difficulties of both the katharsis and the conscious self-illusion. If a tragedy is so well acted that you forget completely that it is only acting and take it for the reality, does it not cease to be art and does not your attitude cease to be æsthetic? It is true, on the one hand, that we feel *emotion* 'in watching what we know to be unreal' just to the extent that we forget that it is

unreal, yet, on the other hand, it becomes and remains a *pleasurable* emotion because we do not wholly forget. It is only because, by this so-called conscious self-illusion, a drainage channel or opportunity for irradiation is kept open, that the stimuli never become summated to the point of pain. That this is the true explanation of the reposeful or pleasurable character of the æsthetic experience even of the drama, Miss Puffer virtually admits when she connects the inevitability, the slipping into its place, the 'coming true' of the action of the drama, with the 'illusion of the triumphant will' (p. 251).

Down beneath the action, the movement, the plot, and the confrontations of the drama in tragedy there must always be this predetermined 'set' of the emotions, this presupposition or predisposition, this element of make-believe or æsthetic Schein, which in physiological language, as we have said, means that the sluice-ways of certain habit-systems are kept open. This is the significance of the insistence of all writers that, even in the case of tragedy the spectator must be left with a sense of control, with the illusion of the triumphant will. Thus it is not true, in a strict sense, that the emotions of the drama aroused are the *same* as those of real life. "The sorrow felt for the suffering hero in the story is unlike real sorrow,"<sup>1</sup> just by virtue of the fact that all the emotions of the drama are discounted by this predetermined 'set' of the emotional habit-systems.

It is not necessary that this presupposition of the æsthetic experience should be continuously in the focus of consciousness. On the other hand, within the limits thus set it seems necessary to the full æsthetic experience that we should get a genuine illusion of the real in the details of the artistic production, so that within these limits we actually "abandon ourselves to its claim to be real, and forget its conflict with our real world."<sup>2</sup> This is the 'illusion in which alone the truth of art resides' of which Howells speaks.<sup>3</sup> "Reality must be suggested, but not so strongly as to destroy the distinction between it and the artistic representation — the beholder must not be hypnotized into belief

<sup>1</sup> Thorndike, *Elements of Psychology*, p. 81.

<sup>2</sup> Hoernle, *Mind*, Vol. 49, p. 17.

<sup>3</sup> *Criticism and Fiction*, p. 76.

in its reality."<sup>1</sup> "We have here the curious pleasure of being deceived and yet a party to a fraud. If the deception were perfect, it would be mere trickery; and yet, too, if there were no deception, we should lose some subtle charm."<sup>2</sup>

And this supplies the key to the true interpretation of the doctrine of katharsis. This means neither purification of the emotions in an ethical sense nor purgation of the soul *from* the emotions, but, as Miss Puffer suggests, it is like being vaccinated instead of having the small-pox (p. 234). But even this metaphor is defective inasmuch and in so far as even the milder form of the disease is disagreeable, whereas the whole process called by Aristotle katharsis is an essential part of the æsthetic experience and therefore pleasurable. But how this may be, is clear from the foregoing analysis. What makes the æsthetic experience pleasurable, as we have seen, even in the case of the portrayal and arousal of the painful emotions of pity and fear in tragedy, is the fact that by reason of the predetermined 'set' of the habit-systems the summation and irradiation of stimulation and response are kept within the limits of the pleasurable functioning of these habit-systems. By the principle of katharsis, therefore, is meant that the elements of stimulation, of variety, excitement, of tension and conflict, the antagonism of impulses, which are contained even in pity and fear, are pleasurable as long as they function within these limits. Katharsis then means the vicarious experiencing of the exciting, stimulating, enhancing effect of any emotion provided it keeps within the limits of habit-functioning which yield a result of pleasure.

### 13. *The Alleged Loss of Self-Feeling.*

If the contention in our criticism is sound, it involves a limitation on Miss Puffer's extreme emphasis on the principle of unity and self-completeness, and gives a positive and paramount importance to the principle of variety, the intellectual factor, in the æsthetic consciousness. The constructive side of Miss Puffer's treatment is almost wholly in terms of a discussion of æsthetic emotion; she has no explicit theory of æsthetic imagery,

<sup>1</sup> Tufts in Baldwin's Dictionary, I., p. 72.

<sup>2</sup> Stratton, *Experimental Psychology and Culture*, p. 118.

of æsthetic judgment, in short, of the intellectual element in the æsthetic moment.

Miss Puffer says: "Now a beautiful object is first of all a unified object" (p. 77). "In it all impulses of soul and sense are bound to react upon one another, and to lead back to one another." 'Thus the unity of a work of art makes' a 'closed circle,' a 'balance,' an 'impregnable and invulnerable circle' (pp. 77, 78).

All this is true only if it first be admitted that in order for the experience to be conscious experience at all, there must be the variety, the stimulation, and antagonism which come from the intellectual or cognitive side. It follows, of course, that her principle cannot be taken absolutely. This she tacitly admits on p. 56 by saying: "Beauty is not perfection, perfect repose, adjustment or habit, but the beauty of the object lies in its permanent possibility of creating the perfect moment."

The extreme to which Miss Puffer pushes the principle of unity is best illustrated in her chapter on 'The Æsthetic Repose,' in which she relates this experience to the phenomena of the mystic and hypnotic trance. Like these experiences, the æsthetic experience is marked by the disappearance of the sense of personality. "Can we deny," she asks, "that all our sweetest hours are those of self-forgetfulness? The language of emotion, religious, æsthetic, intellectually creative, testifies clearly to the fading of the consciousness of self as feeling nears the white heat" (p. 60). "In proportion to the intensity and value of the experience is its approach to the objective, the impersonal, the ecstatic state" (p. 62).

Assuming for a moment the truth of the assertion made by the author that moments of æsthetic absorption and of creative production are accompanied by the 'extinction' of the feeling of individuality (p. 80), let us examine the psychological grounds upon which she bases her argument. The consciousness of self, she says, is the feeling of transition between the foreground and background of consciousness. "I know I am a self, because I can pass, so to speak, between the foreground and background of my consciousness. It is the feeling of transition . . . and this feeling of transition, hunted to its lair,

reveals itself as nothing more nor less than a motor sensation" (pp. 64, 65). "While the self in its widest sense, therefore, is coextensive with consciousness, the distinctive feeling of self as opposed to the elements in consciousness which represent the outer world is based on these bodily sensations which are connected with the relations of objects. . . . The formal consciousness of self might be schematized as a straight line connecting two points, in which one point represents the foreground, and the other the background, of consciousness" (pp. 65, 66). "If we now accept this view, and ask under what conditions the sense of self may be lost, the answer is at once suggested. It will happen when the 'twoness' disappears, so that the line connecting and separating the two objects in our scheme drops out or is indefinitely decreased. When background or foreground tends to disappear or to merge either into the other, or when background or foreground makes an indissoluble unity or unbreakable circle, the content of consciousness approaches absolute unity. There is no 'relating' to be done, no 'transition' to be made. The condition, then, for the feeling of personality is no longer present, and there results a feeling of complete unity with the object of attention" (p. 66).

But this, unhappily, is not the only form in which the author states the matter. She also says that "the self, at any given moment of consciousness, is felt as one group of elements which form a background of consciousness as over against another group of elements which form a foreground" (p. 64), and, in other passages, as we shall see, she speaks of one of the two poles essential to the very existence of a conscious experience dropping out altogether (cf. pp. 73, 75, 83).

What she means, doubtless, is that, as she says elsewhere, "the feeling of transition . . . drops below the threshold" (p. 67), the "feeling of transition disappears with the absence of related terms" (p. 73), the self-feeling disappears with the "disappearance of the transition-feeling, its cause" (p. 84). But if so, we have another difficulty on our hands. If the feeling of transition has dropped from consciousness, how can anything in the way of consciousness be left: how, for example, can she speak of there still being 'an overwhelming

sense of union with the One, the Absolute, God' (p. 73). If there is still an æsthetic *feeling*, then the sense of relationship and transition have at the most only been reduced, they have not been annihilated. Is it not after all, on *her* theory, a mystery, an anomaly, that an experience from which the feeling of transition has dissolved may still be felt not only as 'intense' and 'blissful' but as 'definite' (pp. 83, 84)? And how can an experience be recognized as 'more intense' (p. 85) and even as 'doubled' in *emotional* value (p. 84) if there is no internal articulation, if there is no sense of transitions, no intellectual factor of diversification? And as for 'selfless emotion'—this surely is the quintessence of psychological paradox.

Miss Puffer says that "the loss of the sense of personality is an integral part of the æsthetic experience. . . . It is a necessary psychological effect of the unity of the object. . . . The unity of the object is constituted just by the inhibition of all tendency to movement through the balance or centrality of impulses suggested by it. In other words, the balance of impulses makes us feel the object a unity" (p. 79). "This balance of impulses, this inhibition of movement, corresponding to unity, is what we know as æsthetic repose." The "conditions of æsthetic repose and of the loss of self-feeling are the same" (p. 79). "The true æsthetic repose is just that perfect rest in the beautiful object which is the essence of the loss of the sense of personality" (p. 79).

Miss Puffer further explains the loss of the sense of personality in æsthetic contemplation by saying that we are "held in equilibrium in the object of attention; we cannot connect with it our self-background, for the will cannot act on the object of æsthetic feeling. We cannot eat the grapes of Apples or embrace the Galatea of Pygmalion; we cannot rescue Ophelia or enlighten Juliet. . . . The real ground of the possibility of a momentary self-annihilation lies in the fact that all incitements to motor impulses—except those which belong to the indissoluble ring of the object itself—have been shut out by the perfection of unity to which the æsthetic object has been brought" (p. 78).

But if, as we have seen, the æsthetic experience belongs distinctly to the category of conscious experiences then there must be a subject-object relationship, however subordinated one of the two factors may be to the other. There is no consciousness in which "one term disappears, and the other remains a perfect whole" (p. 83). We have seen that in a value experience there is a characteristic emotional intimacy and integrity which are absent from the cognitive types of consciousness, but the fact remains that there is a certain degree of tension, of relationship. The alleged loss of the self-feeling in æsthetic contemplation must therefore be explained on other grounds than those advanced by Miss Puffer.

The author herself is not quite able to escape the implications of this view of the æsthetic experience, since, where she speaks of one pole of consciousness lapsing, she says, "the remaining, the positive pole of consciousness, is an undifferentiated unity, with which the person must *feel himself one*. The feeling of personality is gone with that on which it rests, and its loss is joined with an overwhelming *sense of union* with the One, the Absolute, God" (p. 73). But if (as indicated in the phrases italicized) there is a 'sense of union' and the person 'feels himself one,' obviously the sense of relationship has *not* totally disappeared.

The author indeed explicitly reckons with this problem. 'Whence,' she asks, comes the 'bliss' of self-abandonment, 'the definiteness and intensity' of the experience in which the sense of self has disappeared? "It is precisely with a fading of self-feeling that intensity and definiteness deepen," she affirms (p. 84). 'The solution of this apparent paradox' she offers is that "if variation in the degree of self-feeling is the common factor, and the disappearance of the transition-feeling its cause, then the lowest member of the scale, in which the loss of self-feeling takes place with mathematical completeness, must be included" (p. 84). But this is like insisting that the unconscious is only a minimal consciousness and frankly, looks like a skillful piece of dialectical sleight-of-hand admitting back by way of the rear door of the 'lowest member of the series' what has been publicly ejected at the front entrance of the formal contentions of her main theory.

The true explanation would seem to be, not that the will 'cannot' act on the object of æsthetic feeling but that it need not because of the relative adequacy of the subject-object relationship in the specific instance. The 'incitements to motor impulse' (*i. e.*, the sense of personality) are not so much 'shut out' as they are incorporated into the situation in such a way that they enrich it from within. These impulses are functional within the situation instead of leading beyond. If they really required to be inhibited, the situation would change to a cognitive instead of an æsthetic experience.

In this same chapter Miss Puffer cites 'the ecstasy of intellectual production' (p. 79) in which she says there is 'the same extinction of the feeling of individuality' (p. 80). But is not this a still more striking refutation of her doctrine? Surely, this is the moment of the keenest and most heightened sense of self as well as of the object. It is an intensely integrated experience, but not exclusively on the side of the object. The integrity and totality and absorption of the experience represents rather the perfection of the control of their interaction than the extinction of either aspect. The condition of artistic creation is not so much 'a lack of outward stimulation,' a 'closed circle' (p. 81), as it is a relative control and adequacy of *all* the conditions. The 'psychological' self, to use Professor Baldwin's distinction, may be said to be absent from such an experience, perhaps, but the 'psychical' self is not absent. It is present, on the contrary, in a fuller and richer way than in any other type of experience. Is it possible that here Miss Puffer has fallen into the psychologist's fallacy and mistaken the lapsing of the 'self-known self' for the lapsing of the 'self'?

Finally, has not Miss Puffer herself hinted at the real truth in the apparent loss of the self-feeling in the principle which she has invoked in her previous chapter — the principle of the 'over-individual' nature of beauty? Is not the so-called loss of the self-feeling to be interpreted, on the positive side, not as a dissolution of the feeling of individuality, but rather its widening and deepening and enrichment, its incorporation into a wider social realization of the self? The conditions of æsthetic repose do not result in the 'loss of the sense of self,' then, but in the

realization of selfhood on a higher plane, in a wider context. The self is experienced in terms of the extra-organic contextual self instead of exclusively in terms of the immediate warm mass of the empirical ego, as Professor James calls it. Such a view, moreover, would harmonize with the experiences of many persons who maintain that their moments of most intense emotional experience and creative activity are accompanied by a heightened sense of selfhood rather than by a loss of the self-feeling. It would harmonize also with all that has been said in the classic treatises on the disinterestedness, the contemplative character and the objectivity and universality of the æsthetic experience.

If 'self-completeness' is the goal of the æsthetic experience, this surely is a more illuminating description of it than one which involves the loss of this very feeling of self. If 'the perfect moment of unity and self-completeness' which is the 'end of beauty' is at the same time to be described as 'repose in excitement' (p. 207), this latter element — excitement — would seem to imply the fullest realization of the *consciousness* of self rather than its extinction.

It might be urged: "We admit that the self is not annihilated but only the sense of self, not self-activity which is rather heightened and enhanced, but only self-consciousness." But is not this just the essence of selfhood — to be *conscious of self as self*? Subhuman nature, the stone, the tree, the animal, is a self in the sense of a center of voluntary activity, but are incapable of artistic creation and æsthetic appreciation — Why? Just because they lack self-consciousness in their activities.

## THE NERVOUS CORRELATE OF PLEASANTNESS AND UNPLEASANTNESS.

BY PROFESSOR MAX MEYER,  
*University of Missouri.*

### CHAPTER II. AN HYPOTHESIS CONCERNING THE STRUCTURE AND FUNCTION OF THE NERVOUS SYSTEM.

If we wish to develop a plain and comprehensive view of the relation between consciousness and nervous activity, especially between pleasantness and unpleasantness and nervous activity, we must first of all develop a plain and comprehensive theory of nervous function. To what extent this latter theory can ultimately be accepted as right, is only of secondary importance in this connection, provided, of course, that the theory does not clearly contradict any facts known beyond doubt. It is easier to change details of a definite theory when necessary, than to make definite a theory which is vague at the start. Let us, then, base our considerations upon the hypothesis described in the following paragraphs.

#### I. *Structural Arrangement of the Nervous Elements: Centralization by Degrees.*

The nervous system of the simplest animals which possess nerve tissues may be regarded as a mere aggregation of reflex arches. By reflex arches we shall mean a system made up of three neurons (compare Fig. 1), a sensory and a motor neuron, and one connecting neuron. Actually, a reflex arch will hardly be found anywhere which does not contain a far greater number of connecting neurons. But here, in attempting to develop a schematic view, this fact may be neglected and a single connecting neuron be substituted for a chain of neurons made up of many links. By motor neuron we mean a neuron which has one of its ends in a motor point of the body, that is, in muscle fibers. By sensory neuron we mean a neuron which has one of its ends in a sensory point of the body, that is, in physiolog-

ical surroundings which particularly favor stimulation of this nerve end under special mechanical or physical or chemical conditions. Neurons which do not have one of their ends in either a sensory or a motor point of the body will be called connecting neurons.

It is self-evident that in all but the very lowest animals there must exist a connection between the different reflex arches.

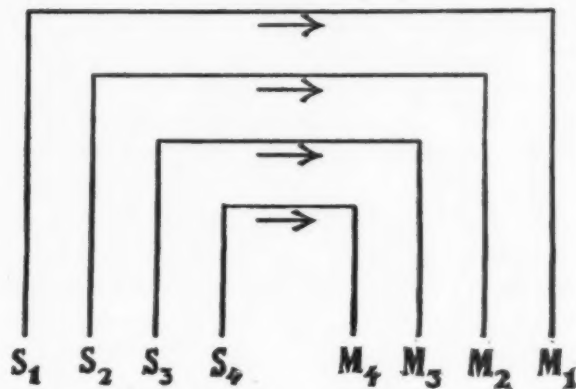


FIG. I.

Otherwise stimulation of a definite sensory point would always and inevitably result in the reaction of the same motor point of the body. But we know that such is not the case. Variations occur, so that the same stimulation which is originally followed by one reaction, is followed later by another. And further, stimulation of one sensory point may result in the reaction of a whole system of motor points; and stimulation of a whole system of sensory points may result in the reaction of a single motor point or at least only a small number of such points. We may use the term 'condensation of the motor process' or 'motor condensation' in order to refer to the latter effect or to the changes by which it is brought about. The term 'condensation of the sensory process' or 'sensory condensation' may refer to the former effect or to the functional changes in the nervous system by which it is brought about. Variation, sensory condensation, and motor condensation are then the three classes of phenomena which a comprehensive theory of nervous function must explain

before we can hope to draw conclusions as to the correlation between nervous and mental functions. In order to explain these phenomena, let us conceive the hypothesis that a number of reflex arches are united into a system as represented by Fig. 2. For simplicity's sake the figure represents only three reflex

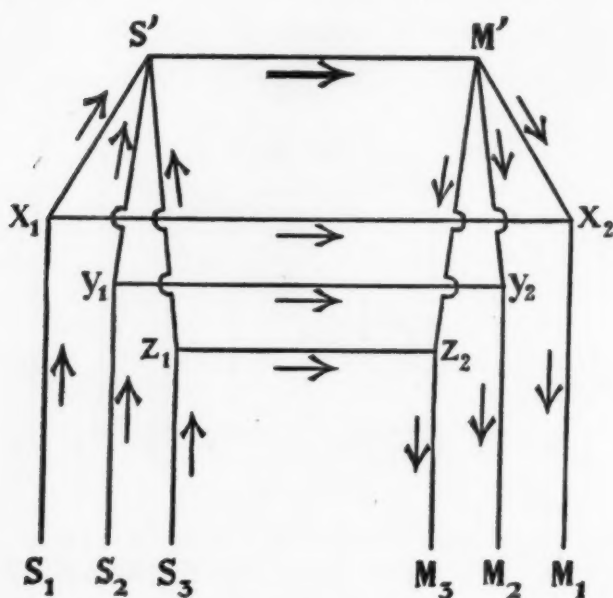


FIG. 2.

arches, but we may conceive the number as high as we want to. We assume that the three sensory neurons which have their peripheral ends in  $S_1$ ,  $S_2$  and  $S_3$ , are connected by three connecting neurons having the common point  $S'$ . We also assume that the three motor neurons which have their peripheral ends in  $M_1$ ,  $M_2$  and  $M_3$ , are connected by three connecting neurons which possess the common point  $M'$ . Let us further assume that the points  $S'$  and  $M'$  are connected by the connecting neuron  $S'M'$ .

The whole system, then, is clearly like in kind to one of the simplest reflex arches from which we started. It is a reflex arch of a higher order. Among the connecting neurons within this system there are some which may be called sensory or

motor, in a relative sense, although they do not have one of their ends in a sensory or motor point of the body. However, those connecting neurons which pass down from  $S'$  are functionally nearer to sensory than to motor points of the body, those from  $M'$  nearer to motor points of the body.

We may now introduce and define a new term, very common in neurological literature, that of a 'nerve center.' Whatever the literal meaning of the word center, we shall mean by it simply an accumulation of functionally related connecting neurons. So we may say that the totality of the connecting neurons which have one of their ends at either  $S'$  or  $M'$  is a nerve center. In order to understand the significance of the terms 'lower' and 'higher' nerve centers, we may further develop the scheme of Fig. 2. Let us assume, as in Fig. 3, an aggregation of three systems, each like Fig. 2, representing any actual number of systems.

The points  $S'$ ,  $S'_a$  and  $S'_b$  are in a relative sense sensory points. We assume them to be connected by three neurons having the common point  $S''$ . The neurons,  $S''S'$ ,  $S''S'_a$ ,  $S''S'_b$ , belong to the class of connecting neurons, since they do not have one of their ends in a sensory point of the body. But in a relative sense they may be called sensory neurons, as being functionally nearer to sensory points than to motor points of the body. Similarly the neurons  $M''M'$ ,  $M''M'_a$ ,  $M''M'_b$  may be called, in a relative sense, motor neurons, although they belong to the class of connecting neurons. The points  $S''$  and  $M''$  we assume to be connected by one neuron, as shown in the figure. We may now regard the totality of the neurons which have at least one of their ends either at  $S''$  or at  $M''$  as a nerve center, and we may name this center  $S''M''$ . This would be, relatively, a higher nerve center, and the nerve centers  $S'M'$ , or  $S'_aM'_a$  would have to be called lower nerve centers. That is, the terms low and high as applied to a nerve center would have to be defined thus: A nerve center is to be called the higher the greater the number of steps (neurons) by which we could reach from it either a sensory or a motor point of the body.

Let us now imagine three systems (representing any actual

number of systems) like that of Fig. 3. Let us assume their, relatively speaking, sensory points  $S''$ ,  $S_a''$ ,  $S_b''$  to be connected by three neurons having a common point,  $S'''$  (compare Fig. 4). Let us assume also their motor points  $M''$ ,  $M_a''$ ,  $M_b''$  to be connected by three neurons having a common point  $M'''$ . Let us assume  $S'''$  and  $M'''$  to be connected by the connecting

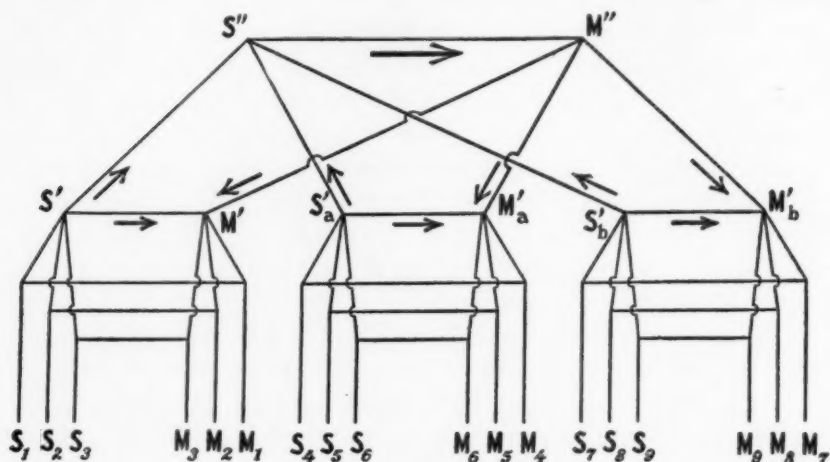


FIG. 3.

neuron  $S'''M'''$ . The connecting neurons  $S'''S''$ ,  $S'''S_a''$ ,  $S'''S_b''$  may then be called, in a relative sense, sensory neurons; and the connecting neurons  $M'''M''$ ,  $M'''M_a''$ ,  $M'''M_b''$ , in a relative sense, motor neurons. The totality of neurons which have one of their ends in either  $S'''$  or  $M'''$ , must then be called a nerve center higher than the nerve center  $S''M''$ , or  $S_a''M_a''$ , these being 'lower' centers in comparison with the center  $S'''M'''$  and 'higher' centers in comparison with others, as we saw above. Let us now conceive this scheme of connections by higher and higher connecting neurons carried as far as the actual complexity of the human or an animal's nervous system would justify. Let us make the hypothesis that any nervous system is a system of connections of essentially the same kind as in the above scheme, and that the difference between the nervous systems of higher and lower animals consists in the existence of 'centers' (as above defined) of a higher order than

found in the lower animals, while the number of simple reflex arches may be identical in both classes.

We must at once raise the question whether this hypothesis agrees well enough with the fundamental neurological facts to deserve to be called probable. I shall mention two facts which seem to agree with the hypothesis.

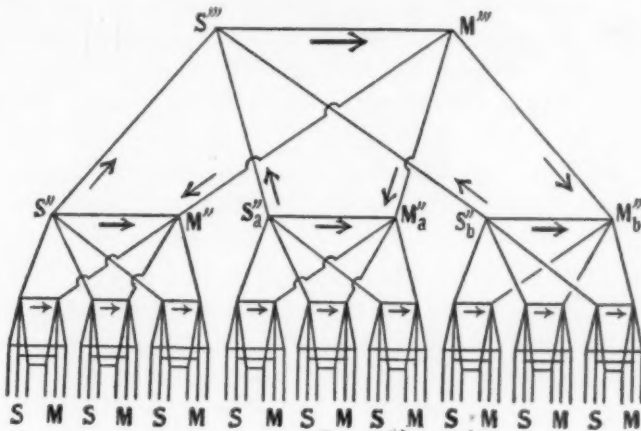


FIG. 4.

If we examine the evolution of the nervous system, we notice that the nervous system shows a distinct tendency towards 'centralization.' Comparing the nervous system of a bird with that of a fish, we notice that it is not bulkier in each of the parts of the body, but that the increase in size is almost exclusively restricted to that part which in man has assumed such enormous size, the cerebral hemispheres. This manner of evolution is to be expected if the new additions to the nervous system serve no other purpose than that of making possible mutual connections of 'the highest centers' previously existing. The new additions are to be expected, then, at the very place where the last additions were made, where the last highest centers were added during the process of evolution, rather than anywhere else. In accordance with this we see the cerebral hemispheres expanding further and further, upwards, towards the sides, the back, and finally in a forward direction, entirely covering, in man, those masses of nervous tissue which were so

conspicuous when we opened the skull of a fish, demanding an enormous cranial cavity for their accommodation. And similar tendencies towards 'centralization' may be found, not only in the vertebrates, but even in invertebrates.

A second fact to be mentioned is the relation between the brain weight and the size of the whole animal organism. I expect to meet with assent if I regard the amounts of variation, of sensory condensation, and of motor condensation possible as measuring the degree of intelligence of an animal. Now, since the nervous tissues enclosed within the skull are not in their entirety higher centers, but to a considerable extent centers of the very lowest kind, that is, mere accumulations of reflex arches, the relative size of the brain cannot immediately be taken as an indication of relative intelligence, for the larger animal needs a greater number of reflex arches than the smaller animal. We must first answer the question, how the size of the brain depends on the size of the body when a species, through evolution, increases in size, but remains on the same level of intelligence. It is clear that the large majority of important stimulations occur on the body surface, where the body is most exposed to the influences of the environment. Stimulations within the internal organs are relatively insignificant. We must expect then, if a species increases in size, but remains on the same level of intelligence, that its brain will increase approximately in proportion, not to its body weight, but to its external surface. We may express this relation also thus: The weight of the brain must be approximately proportional, not to the third power of its linear measurement ( $m^3$ ), but to the second power ( $m^2$ ). If we wish to compare brain weight and body weight, because no other data are available than body weight, we may take the third root of the body weight and raise it to the second power ( $m^2 = c \sqrt[3]{w^2}$ ). If we find that the ratio of the brain weight to this value is larger in one animal than in another we have the right to conclude that that animal excels in intelligence, since there is an excess of nervous tissue above that which is determined by the size of the body, an excess which, as higher nerve centers, can serve the three ends of variation, sensory condensation, and motor condensation. It is

remarkable that ideas like these have only in very recent years begun to find favor with neurologists, that the absurdity of a direct comparison of brain weights or even the ratios of brain weight to body weight, for estimating relative intelligence, has not been noted long ago.

The most interesting application of this principle is to be found in a comparison of the two sexes in man. The absolute weight of the male brain is considerably greater than that of the female brain, the ratio being 1.169 : 1; and fanatics have regarded this as a proof of the intellectual inferiority of woman. It was then pointed out that absolute measurement was valueless because woman is smaller in stature. The brain weight relative to body weight ( $br/w$ ) is somewhat less in man than in woman, the ratio being .967 : 1; and although the difference is not great, fanatics have again regarded this as a proof, but, this time, of the intellectual superiority of woman. The brain weight relative to body surface ( $br/\sqrt[3]{w^2}$ ) is slightly greater in man than in woman, the ratio being 1.029 : 1; and if we take into account that the increase of surface, while being the most important factor, is not the only one, that increase in bulk of the body, although a factor of minor importance, cannot be altogether neglected, our hypothesis concerning the architecture of the brain leads with great force to the conclusion that comparison of the weight of the brain teaches that there is no difference between the intelligence of man and woman. And this seems to be the outcome also of all direct investigations of the relative intelligence of the two sexes.

2. *Function of the Nervous System and its Consequences:  
Variation of Response, Sensory Condensation, Motor  
Condensation, Inhibition.*

Let us now return to our hypothesis of the structure of the nervous system. We assumed that the nervous system consists of reflex arches which are united into groups by higher connecting neurons, that these groups are again united into groups by still higher connecting neurons, and so on, in the manner indicated in our diagrams. We now have to make another hypothesis as to the function of this system, in order to explain the

original relative independence of the reflex arches and at the same time the possibility of variation of response, of sensory condensation, and of motor condensation developing during the individual's life. Let us note, however, that this functional hypothesis is by no means independent of the structural hypothesis, that it would not be applicable to every kind of conception of the structural organization of the nervous system.

It is well to formulate any hypothesis of this kind as far as possible in purely mechanical terms. The present writer does not share the views of those who believe that science must reduce the whole world to matter and motion. Nevertheless it is often preferable to state an hypothesis in mechanical rather than in other terms, in order to make it clear and to understand more readily its consequences.

1. Let us assume, then, that any point where two or more neurons are connected, functions like a valve which permits fluid to pass through only in one, not in the opposite direction, and that this valve opens only in the direction towards motor points of the body. For example, in Fig. 2, a current coming from  $S_1$  and over  $x_1$  reaching  $S'$  cannot pass through either of the other connecting neurons from  $S'$  down to  $y_1$  or  $z_1$ , but can pass on only in the direction of  $M'$ ; and a current coming from  $S_1$  and over  $x_1$  directly reaching  $x_2$  cannot pass up to  $M'$ , but can proceed only in the direction of  $M_1$ . A current which has reached  $M'$ , can proceed thence over  $x_2$  to  $M_1$ , or over  $y_2$  to  $M_2$ , or over  $z_2$  to  $M_3$ . The same principle applied to Fig. 3 would mean, for example, that a current which has reached  $S''$  over  $S'$  can proceed only to  $M''$ , not to  $S_a'$  or to  $S_b'$ ; and a current which has reached  $M'$  over either  $S'$  or  $M''$ , can proceed only in the direction of either  $M_1$  or  $M_2$  or  $M_3$ . No current can normally proceed in the direction  $M'S'$ , or  $M_a'S_a'$ , or  $M''S''$ , or  $M'M''$ .

2. Let us assume that any neuron system has functional properties analogous to those of a pipe system filled with a fluid, one end of the pipe system being usually closed (the sensory point), the other end being under the influence of negative pressure, or suction, tending to produce a current in the direction of this end, the motor point.

3. Let us assume that ordinarily no movement can take place in the pipe system because the sensory end is closed; that the application of a weaker or stronger stimulus means the same as the opening to a lesser or greater extent of the closed end of such a pipe system, thus permitting fluid to escape through the motor point. We assume that the fluid thus lost from the system is replaced in some way or other during the time when there is no stimulation, that is, no opening at the sensory point.

4. Let us assume that the resistance suffered by the fluid in moving through the pipe system depends in the ordinary manner on the length and the width of the pipe. The resistance depending on the length of the pipe line may be measured by counting in our diagrams the number of straight lines (neurons) of which a path from a sensory to a motor point of the body is composed, imagining that each line has the same actual length, whatever its length in the drawing. This does not preclude, of course, innate differences of resistance depending on other conditions.

5. Let us assume that a current has a tendency to widen the pipe in which it is occurring in proportion to its intensity and duration; and that any pipe, while no current is passing through it, has a tendency to grow narrower, gradually and very slowly. Let us further assume that both these properties of the pipe are present in the highest degree in the highest connecting neurons, in lower degrees in lower connecting neurons, and entirely absent in the sensory and motor neurons.

In five divisions we have thus stated a functional theory of the nervous system in mechanical terms. At the present time, when so little is definitely known about the processes going on in the nervous system and yet the need of such knowledge is so strongly felt, it seems to the present writer a decided advantage to be able to think of nervous function in purely mechanical terms, because of the clearness of such terms. But however clear, this hypothesis would be of no value unless its consequences agree with the fundamental facts of mental life. Let us now test the hypothesis in this respect.

Imagine a new-born animal with a nervous system like that

represented in Fig. 3. Let a stimulus be applied to  $S_2$ . At every one of the nine motor points a reaction is possible. At  $M_2$  because of the reflex arch  $S_2 y_1 y_2 M_2$ . At  $M_1$  because of the connection  $S_2 y_1 S' M' x_2 M_1$ . At the motor points  $M_4, M_5, M_6$  because of the connection  $S_2 y_1 S' S'' M'' M'_a$ . But the reaction at the motor points of the second and third groups must be very weak because the current has to go on in seven neurons. At  $M_1$  and  $M_3$  the reaction is not quite so weak because the current has to go on in only five neurons, so that there is less resistance. (The width of the pipe is assumed to be the same everywhere, although this might be otherwise.) At the point  $M_2$  alone a strong reaction is to be expected, since  $M_2$  can be reached from  $S_2$  over three neurons, by way of  $y_1$  and  $y_2$ . It is clear that only at  $M_2$  can a noticeable reaction occur; little or no reaction is possible at the eight other motor points. The function thus far studied illustrates therefore the phenomenon of reflex or instinctive activity, making allowance, of course, for the fact that this is a mere analogy, for no reflex, however simple, may be the result of quite as simple a nervous function.

If this function, the nervous correlate of instinctive activity, occurs frequently and at intervals not too long, according to our hypothesis the path  $y_1 y_2$  becomes somewhat widened—much more so than any of the other paths in which only weak currents have been active. The consequence is that the resistance of this path is slowly, but steadily reduced, that less and less current is possible along other paths, whose resistance is relatively high. In psychological terms, instinct becomes habit. Habit, however, means in this particular case no more than that when  $S_2$  is stimulated the reaction at  $M_2$  occurs even more exclusively, than originally. On the other hand it follows from our hypothesis that an instinct which is never used, through the gradual increase of resistance along the path, may become practically extinct. This might be called a negative habit.

Let us see, now, whether we can derive from our hypothesis the more important form of habit which consists in a variation of the original instinct. It is clear that such variation can come about only by simultaneous stimulation of at least two reflex arches. Suppose  $S_1$  is stimulated simultaneously with  $S_2$ , but

much more strongly than  $S_2$ . According to our hypothesis the current over  $y_1y_2$  must be much weaker than the one over  $x_1x_2$ . To understand the conditions more clearly, we may separate the two reflex arches under discussion as in Fig. 5. Less current

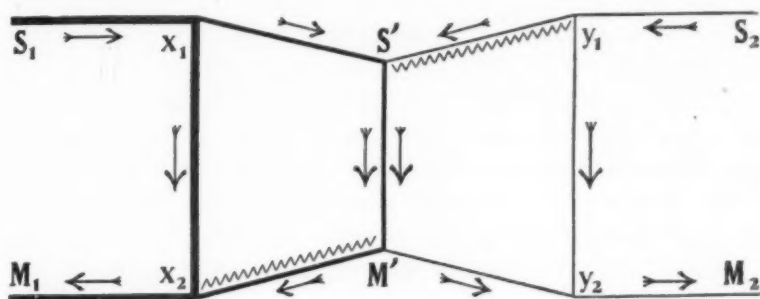


FIG. 5.

is going over the longer paths of higher connecting neurons by way of  $S'M'$ , but here again there is unequal flux; the current in  $y_1S'$  must be much weaker than the one in  $x_1S'$ . These differences in flux are indicated in the figure by the relative thickness of the lines. Here we remember the dynamic principle that hydraulic pressure is less than hydrostatic pressure, of which the jet pump used for drainage or for exhausting air is a familiar illustration. The pressure diminution depends on the velocity of the fluid. It increases much more rapidly than the velocity of the fluid, being proportional to the square of the velocity. The consequence is that the fluid moving over  $x_1S'$  with a velocity greater than that of the fluid in  $y_1S'$  attracts the latter fluid. That is, more fluid takes the path over  $y_1S'$  and less the path over  $y_1y_2$  than in case the point  $S_2$  is alone stimulated. As we have made the assumption that the resistance of higher neurons (*e. g.*,  $y_1S'$  is more easily reduced by currents than that of lower neurons (*e. g.*,  $y_1y_2$ ) the resistance of  $y_1S'$  might soon become less than that of  $y_1y_2$ , although the velocity in  $y_1S'$  did not, perhaps, at any time become actually less than that in  $y_1y_2$ . At the same time the resistance in  $S'M'$  and  $M'x_2$  must decrease because of the great flux from  $S_1$ . Because of the great flux over  $x_1x_2M_1$  the hydraulic pressure at the point  $x_2$  must be low and act upon the fluid in  $S'M'$  as suction, so that

but little of this fluid can move over  $M'y_2$ . The consequence of all this is that an ever-increasing amount of the fluid moving through  $S_2y_1$  moves on in the direction of  $M_1$  by way of the path indicated by the zigzag lines  $y_1S'$  and  $M'x_2$ , an ever decreasing amount in the direction of  $M_2$ . The outcome of this is that when some time later the sensory point  $S_2$  is stimulated separately, the current passes on over  $y_1S'M'x_2$  to  $M'$ , finding here less resistance than over  $y_1y_2M_2$ . That is, the original reflex arch has been put out of function, an instinct has been modified into a habit with a different kind of reaction. Of course, one condition must be fulfilled while the habit is being formed:  $S_2$  must not too frequently be stimulated alone, for this would tend to decrease the resistance of the neuron  $y_1y_2$  and would thus interfere with the development of the variation.

How can sensory condensation be explained on the basis of our hypothesis? The explanation by the aid of Fig. 5 is not difficult. Suppose that the combination just discussed occurs frequently, and that the stimulation symmetrically opposite occurs with about equal frequency,  $S_2$  being stimulated strongly and  $S_1$  at the same time weakly, but that neither  $S_1$  nor  $S_2$  are much stimulated separately. The consequence is that the resistance of  $x_1x_2$  as well as of  $y_1y_2$  increases gradually, whereas the resistance of the path  $x_1S'M'y_2$  as well as of the path  $y_1S'M'x_2$  decreases. The ultimate outcome of this development must be this: When finally the sensory point  $S_1$  is stimulated alone, the current proceeds, not over  $x_1x_2$ , but over  $x_1S'$  to  $M'$ , divides here equally, and equal reactions occur at the motor points  $M_1$  and  $M_2$  simultaneously. And also, when the sensory point  $S_2$  is now stimulated alone, the current proceeds, not over  $y_1y_2$ , but over  $y_1S'$  to  $M'$ , divides here equally, and equal reactions occur at the motor points  $M_1$  and  $M_2$  simultaneously. That is, while two stimuli at  $S_1$  and  $S_2$  were originally required to bring about simultaneous reaction at  $M_1$  and  $M_2$ , a single stimulus is now sufficient for the same result. We have developed the kind of habit which we called sensory condensation.

Our next task is to explain from our hypothesis the development of habits of the kind which we have called motor condensation. This explanation is a simple matter if we recall our

explanation of variation of response. We saw that when  $S_2$  is rarely stimulated alone, but frequently together with  $S_1$  in such a manner that the stimulation of  $S_1$  is stronger than that of  $S_2$ , the channel  $y_1y_2$  tends to close and the current, when  $S_2$  is finally stimulated alone, takes the path  $S_2y_1S'M'x_2M_2$ . It is plain that when this stage of development has been reached, simultaneous stimulation of  $S_1$  and  $S_2$ , whatever the relative intensities of the stimuli at  $S_1$  and  $S_2$ , can result in nothing more than in a reaction at the single motor point  $M_1$ . Thus we explained in mechanical terms, on the basis of a structural and functional hypothesis the three fundamental facts of genetic psychology, variation of response, sensory condensation, and motor condensation. If we look at Figs. 3 and 4, we see at a glance that the application of this explanation to higher and higher 'nerve centers' is in no respect different from the explanation when applied to the nerve center in Fig. 2. That the same rules are applicable throughout must be regarded as a particular advantage of the structural and functional hypothesis upon which the explanation is based.

There is one further conception of fundamental importance in psychology, that of inhibition. I do not, of course, use the term inhibition here in the sense in which it is often used by physiologists, referring to the fact that a certain organ may be made to function rapidly by one kind of nervous influence, to function slowly—or perhaps, in reversed manner—by another kind. I have in mind the fact that a motor reaction expected in consequence of appropriate sensory processes or imagery, is often suppressed by sensory processes or imagery which—without being strictly opposed to that motor reaction—would not in themselves lead to it. For example, a student walking home, suddenly stops on the sidewalk, forgets that dinner is waiting for him, in consequence of thinking of the problem in geometry given him by his teacher. How is this kind of inhibition, which in its most conspicuous appearances is attributed particularly to the very highest nerve centers, to be explained from our hypothesis?

Let us remember our explanation of the variation of response. When  $S_2$  in Fig. 5 is stimulated, we expect a reaction at  $M_2$ .

But this reaction does not take place if a much stronger stimulus is simultaneously applied to  $S_1$ , bringing about a reaction at  $M_1$ . The expected reaction at  $M_2$  is inhibited. It then becomes at once clear why inhibition depends so largely on the function of the very highest nerve centers. In our above case there could be no inhibition if the two systems of reflex arches did not have the higher connecting neuron  $S'M'$  in common. There could be but little of the phenomenon of inhibition in our mental life if we did not possess — in the sense of the diagram of Fig. 4 — very high 'nerve centers,' belonging anatomically to different reflex arches which, as simple reflex arches, are perhaps entirely separate from each other, serving to produce movements which are mutually independent.

### CHAPTER III. A THEORY OF THE NERVOUS CORRELATE OF PLEASANTNESS AND UNPLEASANTNESS.

We are now prepared to raise and answer the question as to the nervous correlate of consciousness. Whoever accepts our previous discussions based on our structural and functional hypothesis can hardly hesitate to answer, that consciousness accompanies processes in the 'higher' connecting neurons, the higher 'nerve centers,' whereas processes restricted to the lower centers may go on without any consciousness. A definite line in this respect cannot be drawn. It is impossible to state just how high the centers involved, how indirect the neuron connections leading from sensory to motor points of the body have to be in order to be accompanied by consciousness. Nevertheless there will scarcely be any objection to the general statement of this dependence. It is also natural to assume that the consciousness must be the more elaborate, consisting of sensory impressions and whole trains of associated imagery, the more indirect the paths taken by the current, the more delayed accordingly the motor response.

What then is the nervous correlate of pleasantness and unpleasantness? If we held, as one of the psychologists mentioned, that unpleasantness was merely a weak sensation of pain and pleasantness merely a weak sexual sensation, then no further answer would be necessary, the answer would have

been given already. But we hold that pleasantness and unpleasantness are states of consciousness differing in kind from sensations, perceptions, images, ideas. One principle must be adhered to. We must not multiply conditions beyond need. We must apply the same views without change as long as comparison with the facts of experience permits. We have assumed that sensation and imagery depend on activity of the higher connecting neurons of the nervous system. Let us therefore assume that pleasantness and unpleasantness too, depend on activity of the higher connecting neurons. But if pleasantness and unpleasantness are different in kind from sensation and imagery, then the kind of 'functional' (in a mathematical sense) relation between nervous activity and pleasantness and unpleasantness is likely to be found to be a different one.

Asking, then, the question as to what constitutes the nervous correlate of pleasantness, we give this answer. The nervous correlate of pleasantness and unpleasantness must be *some form of activity in the higher nerve centers*, since it is generally admitted that only activities in the higher nerve centers are accompanied by consciousness, and pleasantness and unpleasantness are kinds of consciousness. But while the correlate of sensation is the nervous current itself, the *correlate of pleasantness and unpleasantness is the increase or decrease of the intensity of a previously constant current if the increase or decrease is caused by a force acting at a point other than the point of sensory stimulation.*

Some psychologists will doubtless be quick to raise the objection that the correlate of a mental state must be a 'physical state,' a nervous process going on in a mysterious 'feeling center,' that it is *inconceivable* that the nervous correlate of pleasantness or unpleasantness could be a mere increase or decrease in the rate of flow. However, things are often inconceivable for the sole reason that they have never been conceived. That heat, light, magnetism, electricity, are anything but substances capable of flowing from one place to another has been inconceivable to some, that they are anything but forms of vibratory motion of a hypothetical ether has been inconceivable to others.

And still there are those who conceive of them as mere periodical changes in the distribution of energy. If preconceived notions were less strong in psychology than anywhere else in human activity, the psychology of feeling would long ago have passed out of the state of confusion in which we find it at present. Nothing is inconceivable but that which implies a logical contradiction. The theory above advanced does not contain such a contradiction. Its scientific value, of course, is not proved thereby, but depends on its capacity for bringing the varied experiences referred to by feeling or by pleasantness-unpleasantness under a clearer and more comprehensive formula than other theories are capable of. That there is an increasing tendency among psychologists toward some such theory as the above appears from some of the views reported in our historical introduction and similar views expressed in some recent text-books on general psychology. However, I do not know of any attempt at giving this theory any formulation which can compare in definiteness with the one presented above.

The most difficult part of our task is still before us, that of showing that the varied experiences of pleasantness and unpleasantness become easily intelligible as special cases of the general fact stated. The difficulty of this task, however, is not—as is often the case with theories—the result of a lack of definiteness; it is the consequence of the enormous complexity of the conditions under which pleasantness and unpleasantness come to be felt in ordinary life. We must therefore restrict ourselves at present to applying our theory to a number of typical instances.

1. *Pleasantness-Unpleasantness Does not Occur Apart from Perception.*

Writers on psychological theory usually emphasize the fact that pleasantness and unpleasantness seem to lack independence, that they cannot occur alone but only as an accompaniment of sensory or ideational states. Some have felt constrained under these circumstances to assume that pleasantness and unpleasantness are attributes of all sensations, that every sensation has a feeling-tone, positive, negative, or indifferent. This doctrine

of the feeling tone of sensation must be rejected because it does not fit such cases as that mentioned by Miss Calkins where a person mistakes an ice-cream fork for an oyster fork. But it must be admitted that pleasantness and unpleasantness never occur alone, separate from sensory or ideational mental states. Now this is just what is to be concluded from our theory. There can be no increase or decrease of a nervous process without the nervous process existing itself. Therefore there can be no pleasantness or unpleasantness without sensory or ideational content. On the other hand, a nervous process can exist without increasing or decreasing. It is true that a nervous process cannot come into existence without increasing or go out of existence without decreasing. But this increase or decrease is the consequence of conditions existing at the point of stimulation, and is therefore, according to our theory, not the correlate of any pleasantness or unpleasantness.

## *2. Pleasantness-Unpleasantness Is Not Localized.*

Excepting a few psychologists there is a general agreement that pleasantness and unpleasantness cannot be localized, whereas all sensations can be localized, although not always very exactly. Nothing else could be the case according to our theory. We can localize the sensory point from which a nervous process takes its origin, for instance, by imagining the visual appearance of that sensory point amidst its surroundings. But it is obviously impossible to have, visually or by other sensations, any experience of the point within the central nervous system where the decrease or increase of the nervous process originates. Sometimes, however, we know or think we know that the decrease or increase has its indirect cause in a certain sensory stimulation, as, for example, when we are studying and hear our neighbor's piano. Some psychologists may describe this experience by saying that they localize unpleasantness in the ear, but the majority will probably insist that the unpleasantness of this experience is not localized anywhere, that the sound only is localized in the ear.

### 3. *Certain Sensations Are Usually Unpleasant.*

Certain sensations, for example, pain, bitterness, acidity, are nearly always unpleasant. But it would be misleading to state that this is the feeling-tone of these sensations — a doctrine which we have already rejected. Many articles of food which are but slightly sour or bitter, are pleasant to eat. And psychologists are coming more and more to recognize the fact that even the sensation of pain, in its lower degrees, is not invariably unpleasant. The relation of these facts to our theory is not difficult to see. One may distinguish two ways in which the sensation of pain may be brought about, by a movement on the part of the subject, as when I lift my hand and thus come in contact with a sharp instrument, and by an influence of another kind while my body is at rest, as when I am unawares bitten by a dog. However, there is no fundamental difference between these two cases, for rest too, in ordinary life, means a definite kind of muscular innervation. Now, if my nervous organization, by both instinct and habit, were such that the nervous processes going on at the time when my hand was bitten could remain the same after this event as before, the probability is that the dog would bite me again and would thus diminish my chances for life. It is entirely in accord with what we must expect from the necessities of life when we find that the sensory processes resulting from the application of the dog's teeth bring about cessation of the muscular innervation existing at that moment and substitution of another kind of muscular activity. We see at once that for this purpose it is necessary and unavoidable that I be so organized nervously that the two processes, the one which results in what we called rest and the new one which originates from the point where my pain nerves were stimulated, and which results in withdrawal of the hand and in other movements of defense, meet somewhere in the nervous system. According to our structural hypothesis any two nervous processes can meet somewhere. As soon as the second process meets the first, it will through its own greater intensity detract from the first process and thus bring about the cessation of the muscular activity which had existed up to the time of biting. If the meeting of the two nervous processes occurs in 'nerve centers' which

are not very high there is no accompanying consciousness. The movement of defense would be called instinctive or automatic. Something like what we have described might occur during sleep without the subject's awaking. But if the meeting occurs in a very high nerve center, there must be the consciousness of the sensation of pain and other ideas associated. The defensive movement in this case would be called voluntary. And now, there must also be, according to our theory, a conscious state of unpleasantness whose intensity depends on the *rate* at which the first nervous process is *deflected* from its original course into that of the second process — which is identical with the rate at which the original flux is *decreased*. The flux of the second process is thus increased, but this, according to the theory, does not result in pleasantness because the second process is only establishing itself, has not previously been constant.

It is not strange, then, that the sensation of pain is nearly always accompanied by unpleasantness. But there are some, though rare, cases where the sensation of pain is not accompanied by unpleasantness. From our theory we can understand these cases as well as the more common case just discussed. Those, for example, who are chronically sick and suffer constant pain, would only injure themselves by reacting upon pain as a normal person reacts upon a dog bite. They learn to continue the muscular activity in which they are engaged even when the sensation of pain suddenly makes itself felt. That is, the new nervous process is no longer able to meet the first process, to detract from the first process, but takes its separate path leading to some kind of muscular activity irrelevant to the subject. According to our theory there can then be no unpleasantness. Psychologists have often thought to give a complete description of such a case by simply stating that the invalid pays no attention to the sensation of pain. While it is doubtless true that very often he does not pay any attention to the pain, that very often the second process does not reach any higher centers, in the opinion of the present writer this is not the whole truth, but must be supplemented by showing that even when attention is paid there need not be any unpleasantness; and this we have shown above.

Imagine a scientist, perhaps a psychologist, studying experimentally the sensation of pain. He cuts out a piece of his skin and records carefully how the sensation of pain develops. It is not astonishing if we are told that, although he felt the sensation of pain, he felt no unpleasantness. If the nervous process starting from his pain nerves had interfered with, detracted from those processes going on at the moment, his experiment would have been a failure because it would have been cut short. If he is so interested in the experiment that he succeeds in bringing it to the proper end, then there can have been no unpleasantness, for there has been no deflection of his nervous processes. There might have been even pleasantness, for the sensation of pain, being expected, may induce the experimenter to cut further. The nervous process starting from the sensory nerves of pain in this case did not take any course of its own, but joined the nervous processes going on at the time when it started, increasing their intensity.

Insects have bitten us, and the itching thus caused produces scratching movements. Pain is the result of the scratching; but this pain is by no means unpleasant, rather pleasant. Why? The pain does not stop us scratching. On the contrary we scratch the more for it. The nervous process starting from the pain nerves joins the process going on when the pain was first produced. However, if the pain becomes too strong, then the sensory process of pain intercepts the previous process, a typical pain reaction follows, scratching ceases, and unpleasantness is felt.

If a sour or bitter substance is put in an infant's mouth, the instinctive response is that of spitting. The new nervous process intercepts those going on at the time, and unpleasantness is felt. While the tastes of sour and bitter are invariably unpleasant to children, they are often found to be pleasant in older people unless they occur in too strong a degree. Some people like bitter beer and sour pickles. How does this come about? The answer is not difficult. If for one reason or other, that is, under the influence of strong nervous processes which overpower the instinct, sour or bitter food is frequently taken, the resistance of the path representing the original instinct is increased, accord-

ing to our theory, and a new nerve path of small resistance leading to the movement of sucking and swallowing is formed. Whenever now a movement occurs which brings a slightly bitter substance into the mouth, for instance the movement of sucking beer from a mug, the nervous process resulting from the bitter stimulation is of essentially the same kind as the one which has been going on and therefore simply joins it, increasing its intensity. According to our theory pleasantness must then be experienced.

But why should the sensation of bitter be unpleasant to the same subject when recurring in a much higher degree, caused, say, by a dose of quinine? Now, we did not say that the original (instinctive) nerve path has been entirely obliterated. The stronger the stimulus the greater the diffusion of the nervous process. This diffusion is to be expected particularly in the direction over the original path. This path was by inheritance, and is still, connected with a large number of the most ordinary motor paths, in order to insure to the animal the protection so necessary against getting harmful substances into the mouth. It is highly probable, then, that this strong process passing over the instinctive path will be joined by other accidental nervous processes, that thus it will become still stronger until its intensity becomes greater than that of the other branch passing over the habit path. Immediately, according to our theory, the habit process is intercepted and the original instinct has for the moment full sway. Unpleasantness is the logical consequence.

Although there is a natural aversion against tobacco, alcohol, and other drugs, their taste and smell, etc., may be made pleasant by simply using these substances persistently in spite of the original instinct, till the instinct is sufficiently weakened, that is, the resistance of the reflex arch sufficiently increased. The establishment of the habit must be quickened, of course, by changes in the chemical constitution of the nervous system and the sense organs, which take place in consequence of the organism's adapting itself as well as possible to the continued prevalence of unnatural conditions.

#### 4. *Certain Sensations Are Usually Pleasant.*

Certain sensations are almost invariably pleasant. Sweet and sexual sensation are good examples, so much so that some psychologists, as we saw in our introduction, have been misled into regarding pleasantness as a weak sexual sensation. It is plain that, if animals were so organized nervously that the nervous process starting from stimulation of the sexual sensory nerves were likely to intercept those nervous processes leading to the muscular innervation existing at the moment of stimulation, fertilization of the ovum and thus propagation of the race would be a highly improbable occurrence. But the nervous system of all animals is by inheritance of such a structure that the higher connections of the reflex arches and the distribution of resistances cause the nervous process starting from stimulation of the sexual sense to join those processes existing at the moment of stimulation, to increase the intensity of the muscular innervation of this moment. The result is, according to our theory, pleasantness.

Nevertheless there are cases where the sexual sensation is indifferent or even unpleasant, just as there are cases where the sensation of pain is pleasant. Both the possibility and the comparative rarity of the sexual sensation's being unpleasant are easily comprehended from our theory. In a similar way the theory can be applied to the familiar experiences of pleasantness or unpleasantness of the sensation of sweet.

#### 5. *Sensory and Intellectual Pleasantness and Unpleasantness.*

The chief objection to the doctrine of a feeling-tone of sensation is this, that pleasantness and unpleasantness accompanying ideational states are in a grown person's life much more numerous and also, on the whole, much more intensive than pleasantness and unpleasantness accompanying sense impressions. It must be regarded as one of the points of superiority of our theory that it helps us to comprehend this fact without forcing us to distinguish sensory and intellectual pleasures as two different classes of mental states. According to our theory pleasantness can exist only when one nervous process is increased by a second and weaker process which is forced to join

it partially or wholly; unpleasantness can exist only when one nervous process is decreased by being partially or wholly intercepted by a second and stronger process. Such influences of a second nervous process on the intensity of an existing nervous process are possible only if the two processes meet somewhere in higher connecting neurons. It is at once clear that, as a rule, processes passing from sensory to motor points of the body over very indirect paths, by way of the highest connecting neurons, the 'highest centers,' are more likely to meet and interfere with each other than those which reach motor points of the body over very direct paths. The latter, however, are the nervous correlate of simple sensations and perceptions, the former the correlate of the more complex conscious processes made up of percepts and ideas, possibly long trains of thought. We comprehend thus why, on the whole, the highest intellectual activities give us the most intensive experiences of pleasantness and unpleasantness, whereas pleasantness and unpleasantness accompanying mere sensations are rather insignificant in the mental life of a person of culture.

#### 6. *Positive and Negative Quantities.*

Pleasantness and unpleasantness have been regarded by many writers as positive and negative quantities the balance of which alone could have actual existence in conscious life. The present writer, from the introspective evidence of his own life, agrees with those psychologists (*e. g.*, Lipps) who hold that pleasantness and unpleasantness can exist at the same time. The belief that they exclude each other seems to have originated from the observation that when there is much pleasantness, there is, as a rule, no unpleasantness at all, and the reverse. Our theory explains, not only the fact just mentioned, but also the coexistence of pleasantness and unpleasantness in less frequent cases. We rarely do two things at the same time. This is a fact which we recognize as such without having to comprehend its biological sources. Doing one thing, however, does not mean that there is, in the strictest sense, only one nervous process passing through our organism from one sensory point to one motor point. Thousands of sensory neurons are stimulated and

thousands of muscle fibers receive innervations from their motor neurons simultaneously. But all these nervous processes must be thought of as running parallel, without any mutual interference. Recalling our Fig. 2, and supposing the reflex arches  $S_1M_1$ ,  $S_2M_2$ ,  $S_3M_3$  to represent such parallel nervous processes, it is easily seen that any other process which, at a higher connecting neuron, causes any increase or decrease of one of the processes in these arches must influence all others in a similar way. It is quite comprehensible, therefore, that ordinarily we experience either pleasantness or unpleasantness or neither, not both. But the nervous system is made up of such an enormous number of reflex arches and such a complicated hierarchy of nerve centers that doubtless nervous processes may go on somewhere within it and simultaneously other processes elsewhere so that a third class of processes may cause an increase of intensity in the currents of the first class and simultaneously a fourth class of processes a decrease of intensity in the currents of the second class. Thus pleasantness and unpleasantness do not necessarily exclude each other. But owing to the generally prevailing tendency of centralization of nervous function there will be, as a rule, at any moment either pleasantness without unpleasantness or unpleasantness without pleasantness, or neither. To describe pleasantness and unpleasantness as positive and negative quantities seems to the present writer pure speculation which arbitrarily disregards all introspective evidence to the contrary.

#### 7. *Emotions and Pleasantness-Unpleasantness.*

It follows from our theory that the more nervous activity, that is, the more numerous and widely distributed the nervous currents, the more chances there are for intense feelings of pleasantness and unpleasantness. A good example of a wide distribution of the currents over the nervous system is an emotion of an adult human being. The consequence is, on the one hand, the complexity of organic sensation so characteristic of an emotion; on the other hand, the intensity of the pleasantness experienced, or unpleasantness, or both. The former has been most lucidly described by Lange, most successfully applied to psycho-

logical theory by James. The latter consequence, however, has never been clearly understood. The fact that pleasantness and unpleasantness are almost invariably and in great intensity found in emotion has led to the deplorable confusion of psychological terminology, where 'feeling' sometimes stands for an unanalyzed complex of organic sensations, sometimes for the pleasantness-unpleasantness experience, sometimes for both. The present writer cannot help believing that many of the contradictory results of experimental work on feeling of recent years would have resolved themselves and given place to perfect clearness if both experimenters and subjects had worked on the basis of some such theory of pleasantness and unpleasantness as has been presented above.

To avoid misunderstanding it may be stated here expressly that, although emotions of grown human beings, according to our theory, must nearly always be accompanied by strong pleasantness and unpleasantness, our theory does not require that states of consciousness of the kind which some psychologists would call emotions, for example the consciousness of lower animals or small children, must inevitably be accompanied by pleasantness and unpleasantness.

#### 8. *Attention and Pleasantness-Unpleasantness.*

Our theory throws some light on certain problems connected with the theory of attention. 'Interest' has been defined by some psychologists as acquired capacity for attention, as distinguished from strictly native capacity for attention. Other psychologists have defined interest as attention accompanied by pleasantness. If our theory of the nervous correlate of pleasantness and unpleasantness is accepted, both definitions have the same meaning. Imagine you are interested in the presidential election. You have heard the dinner bell and are rising from your chair. The cover of a magazine strikes your eyes, on which you read the title of an article on candidates for the presidency. This interferes with your walking to the dining room and you experience a brief unpleasantness. Perhaps you decide not to take any dinner, but to find out immediately what the article has to say. While you are reading the paper, every

stimulation of your sense organs other than the sight of the printed pages is unable to reach its motor end, but must join and increase the intensity of the process of reading, because of your acquired capacity for reacting strongly upon words and sentences which have the meaning of politics. According to our theory you experience pleasantness. Thus we see that an acquired capacity of attention can result in unpleasantness at the moment when attention begins and must result in pleasantness as long as attention in the same direction continues. This continued pleasantness is much less likely to occur in a case of native attention; for the reflex arches which are the condition of native attention do not pass over the highest centers and thus are not to the same extent capable of forcing newly arising nervous processes to join them instead of running their own course. The nervous paths which are the condition of a highly developed acquired capacity for attention, are in contact with innumerable higher centers and are thus capable of forcing almost any newly arising nervous process to join and increase the habit process in question.

#### 9. *The Causes of Action.*

Many writers on psychological topics have urged that it causes confusion in theoretical thought to speak of pleasantness and unpleasantness as causes determining our action. Fite, in the paper mentioned above, has strongly urged the necessity of this view denying causality to pleasantness and unpleasantness, in ethics, though unfortunately he has failed to make the necessary distinction between unpleasantness and the sensation of pain. According to our theory of their nervous correlate pleasantness and unpleasantness cannot be regarded as causes of action in the sense in which sensations and ideas are causes of action. The nervous correlate of a sensation is a nervous process starting at a sensory point, passing over a definite path of connecting neurons, and ending in a motor point of the body. The sensation (or perception, if it is a unified group of sensations) preceding the movement may justly be called the cause of the movement. If the nervous process passes over higher connecting neurons which have previously been excited from

different sensory points of the body we experience imagery. These images may justly be called the cause of the action, for this movement would not have taken place in response to this sensory stimulation if the nervous current had not taken this very path over higher connecting neurons. The fact, however, that a current, after becoming established, suddenly suffers an increase of intensity at an interior point of the course is not a necessary condition of a particular reaction, for, conditions in general being favorable, the same reaction can occur without a sudden increase of the nervous process. Therefore, if we regard pleasantness as the mental correlate of the increase in question, we gain clearness by abstaining from calling pleasantness the cause of the action. On the other hand, without this increase of intensity, the action might have suffered inhibition before it had been carried out in all its phases, so that, in this sense, the pleasantness may be called the cause of this action under these special circumstances of nervous activity, just as we often in daily life refer to pleasure as the cause of an action. However, those psychologists seem to have chosen the safer course who refrain from speaking of pleasantness as a cause of action, because thus they are induced to look for the more important, the ultimate causes of the particular response, for the sensory stimulation of the moment which leads to this response and the sensory stimulations of the past which have prepared the way for it; and looking for these ultimate causes in each particular case, they are more likely to discover them than those psychologists who are not in search of them, but are satisfied if they can assert that pleasure had something to do with the response.

10. *No Images of Pleasantness-Unpleasantness.*

Some psychologists have stated that 'feelings' cannot be imaged, revived, as sensations can. If by feelings are meant exclusively pleasantness and unpleasantness, we must agree with this view. According to our theory pure sensory impression occurs when a nervous process passes rather directly into a motor point of the body, imagery when it takes an indirect path over higher connecting neurons over which a different process

has previously passed from a different sensory point of the body. But the mere increase or decrease of a current, which according to our theory is the nervous correlate of pleasantness and unpleasantness, has no reference to directness or indirectness of the nervous path, and its mental correlate, therefore, cannot be expected to show any corresponding distinction.

#### II. *The Latest Product of Mental Evolution.*

Most psychologists hold that feeling is the most primitive form of consciousness, that sensation is the next higher stage of mental evolution, and ideation the highest. There may be truth enough in this, if by feeling is meant certain kinds of emotion which consist of vague undifferentiated sensation groups. But if by feeling is meant pleasantness and unpleasantness, the truth is probably that these represent rather the highest stage of nervous activity than the lowest. It is obvious that according to our theory of their nervous correlate pleasantness and unpleasantness are the highest product of mental evolution. They cannot exist in animals which are governed by ready-made and invariable reflexes. Only where, through mediation of higher nerve centers, variation of response becomes possible, can pleasantness and unpleasantness be experienced. And only in the highest animal, in man with his highly centralized nervous system, can they reach their highest degrees. That this is opposed to psychological tradition does not prove that it is wrong. The tradition has its origin in the lack of distinction between emotion on the one hand and pleasantness-unpleasantness on the other. The writer's own introspection seems to agree better with the consequence of the theory here developed than with the traditional view. His earliest childhood as remembered was characterized by primitive emotions of the purely instinctive type; but pleasantness and unpleasantness have made themselves felt the more strongly the more his education has advanced, the more his nervous processes have become able to interfere in the most manifold ways with each other. That a child laughs and cries more than an adult is true; but that a child experiences more pleasantness and unpleasantness does not follow. That the consciousness of the lower animals is a kind of primitive

emotion, made up of vague, unanalyzed complexes of organic and external sensations, may be admitted. Analyzed sensation and perception may be the next stage; but here gradually pleasantness and unpleasantness can make their appearance in mental evolution, reaching their highest development where the ideational processes attain their highest development, in the adult educated man.

Someone might raise here the question: If pleasantness and unpleasantness can not be 'imaged,' how can you 'remember' that they were less intense in childhood than in adult life? The answer to this question is this: I can know by memory that certain experiences of my present life are very much like those rather simple experiences of my childhood, and that other experiences in my present life are incomparably more complicated than any which ever occurred in my childhood. Now, if I know that the latter, the more complicated experiences, are, as a rule, distinguished by the most intense pleasantness and unpleasantness, I have a right to conclude that childhood is comparatively poor in pleasantness and unpleasantness.

The question may also be asked, how pleasantness and unpleasantness, if it is true that they are not the causes of our actions, can nevertheless induce a person to sit down at his desk and write a treatise about them. Here it must be understood that their causality has not been absolutely denied, that it has merely been held that their causality is a less direct one than that of sensations and images, and that, as a rule, we obtain a clearer insight into the causal connections in mental life by disregarding pleasantness and unpleasantness as causes than by using them as an ever-ready explanation for any actions whose origin is unknown.

#### SUMMARY.

By a study of the theories of various writers on pleasantness and unpleasantness we convinced ourselves of the great need for clearness in this field of psychology. In order to obtain this clearness, we found it necessary to develop a definite theory of nervous function. We could not develop this without first making a definite hypothesis as to the structural arrangement

of the elements of which the nervous system is composed. Thus we were enabled to advance a theory of the relation between consciousness and nervous function, in particular between pleasantness and unpleasantness and nervous function. This theory we applied to a number of specially important facts and found that these facts, otherwise rather isolated and not easily comprehensible, appear now as logical consequences of the theory, as an easily comprehensible system of psychological facts having this theory as their common basis.

## CORRELATION OF CERTAIN MENTAL TRAITS IN NORMAL SCHOOL STUDENTS.<sup>1</sup>

BY PROFESSOR HARVEY A. PETERSON,  
*Nashville, Tenn.*

Investigations of the correlation of mental abilities are fairly numerous, but they are principally of two kinds: first, correlations of proficiency in the various school and college studies, and secondly correlations of the simpler mental processes. A glance at the results will be in place here. There is very little correlation between drawing and the other studies, but there is a considerable amount between the latter studies themselves, usually from 30 to 60 per cent. The surprising feature is that there is as much correlation between the languages and natural science as there is among the languages, and as much between history and natural science as between history and the languages, in short with a few exceptions, "whatever it is that makes for correlation in class standing seems to hold generally for all courses."

The other type of investigation, that of mental processes, has confined itself to quite simple processes. The accuracy shown in bisecting a line, or in striking dots printed on a sheet of paper, or in estimating weights, or in keeping a rhythm is compared with the quickness shown in simple reaction, or in naming colors, or in the association of ideas. Again these are compared with the visual memory for numbers. Often two tests of the same supposed trait, for example accuracy, have been compared with each other, on the theory that correlation among quite different processes was not to be expected. It is significant in this connection that more correlation has been found among the apparently complex processes involved in the school studies, than among the simpler mental processes like those mentioned.

Neither line of investigation has so far given us types of mind, which, however numerous they might be, would be of

<sup>1</sup> The MS. of this article was received May 3, 1908. — ED.

use in practical life and in educational theory. For while the investigations of school abilities connect with practical life, they do not give us *complete pictures of individuals*, even on the school side of life. We do not know how individual persons stand in all their studies, *i. e.*, types are lacking. And the studies of mental processes, in the effort to obtain simplicity, have devised tests in many cases removed from life, for example, picking out words containing r and e, or remembering series of numbers. Further, the higher processes of reasoning, generalizing, comprehending abstract thought, art appreciation, moral sensitiveness, etc., are left untouched.

The following investigation belongs to the second group, but it has sought to bring in some of the so-called higher processes, in particular some which play a leading part in acquiring knowledge. It has also been on the lookout for evidences of types of scholastic mind, and for this reason the effort was made to make the tests somewhat comprehensive. Five tests each taking from 30 to 70 minutes were given to a class of second-year normal and college students. The average age was 21 years.<sup>1</sup> The normal school students greatly preponderated. The traits tested were accuracy in copying a bibliography, memory for simple connected thought, deductive reasoning, generalizing power, and power to comprehend abstract thought. The tests were given during five of the regular periods of a course in elementary psychology. They were scattered through a half-year at intervals of a week or more, and the first one was not given until two months of the course had passed. Enough time had elapsed for the students to be familiar with the vocabulary involved in the accuracy test, and to know what generalizing meant when that test was given. In all cases the tests were given under the eye of the instructor, to small sections of the class, numbering not over 35, under conditions which prevented communication and copying.

#### I. ACCURACY.

The students did not know that this was a test, as it was given first in the series and before any announcement that a

<sup>1</sup> Average deviation, 2.9 years.

series of tests would be made. The bibliography given below was on the blackboard when they entered the room. They were asked to copy it in their notebooks as it stood, without abbreviating it or making any other changes in it. They were allowed as much time as it took the slowest student to finish, and at the end of the hour the notebooks were collected and the pages containing the test were removed. Thus the exercise was a fair test of how accurate they were in the ordinary pursuit of their courses when they were not on their guard. Inquiry after all the tests had been completed showed that only one person in a section of 35 students suspected that it might be a test. In grading the papers only certain classes of errors were taken into account, such as misspelling the names of authors or the titles of books, errors in the paging, volumes and dates of books and magazines, omission of a dash between the first and last pages or chapters of a reference, omission of the word translation. Errors in punctuation and capitalization were not counted, and in general the aim was to take account of such errors as would tend to hinder the use of the bibliography in a library.

*Sensations.* — Chapters I.-VII. of *An Introduction to Physiological Psychology*, by T. Ziehen (translation), or *The Analysis of Sensations*, by E. Mach (translation).

*The Sense Organs.* — *The Physiology of the Senses*, by J. G. M'Kendrick and W. Snodgrass.

*An Experimental Study of Connections of Impression.* — Chapters V. and VI. of *Analytical Psychology*, by L. Witmer. Experimental.

*Apperception.* — 'The Reading of Words: A Study in Apperception' (in the *American Journal of Psychology*, 1897, VIII., 315-93), by W. Pillsbury; and 'The Apperception of the Spoken Sentence' (in the *American Journal of Psychology*, 1900, XII., 80-130), by W. C. Bagley.

*The Physiological Basis of the Emotions.* — Chapters IV. and V. of *Pleasure, Pain and Aesthetics*, by H. R. Marshall. Chapters V. and IX. of *An Outline of Psychology*, by E. B. Titchener. Volume I., Pt. II., ch. IX., of the *Principles of Psychology*, by Herbert Spencer.

*Feelings of Relationships.* — Pages 243-65 of Vol. I. of *The Principles of Psychology*, by Wm. James.

*Feelings of Meaning.* — On the question whether all thoughts and feelings can be classified as general notions, individual notions and abstractions: secs. 89-92 of *A Primer of Psychology*, by E. B. Titchener.

## II. MEMORY.

The selection given below was read to the class. They were told in advance that it was a memory test in which they would be asked as soon as the reading was finished to recall on paper as much as possible; that recalling the language used was not a part of the test, but they should try to recall as many details or facts as possible. A week later with no warning or refreshing of their memories they were asked to write again as much of the selection as they could recall. In both cases there was no limit on the time, the papers being collected when the last student ceased writing.

*Noah Webster.*

“Noah Webster was born October 16, 1758, in Hartford, Connecticut, about three miles from the center of the city. His father, Noah Webster, Sr., was a respectable farmer, a deacon in the church, and a justice of the peace. The boy worked on the home farm and attended the village school. When he had reached the age of fourteen, we find him beginning the study of the classics under the instruction of the parish clergyman, and two years later he was admitted to Yale College. The Revolutionary War seriously interrupted the college course, but he graduated with credit in 1778, and his father gave him an eight-dollar Continental bill, then worth about half its face value, and told him he must henceforth rely on his own exertions.

“It had been young Webster’s intention to become a lawyer. The country, however, was impoverished by the war, and his first necessity was to make a living. So he resorted to school teaching. Pedagogy at that time was attended with unusual difficulties. Not only was the war still in progress, but the interruption of intercourse with Great Britain had made school-books very scarce. The need of a home source of textbook

supply was evident, and in 1782, while in charge of a school in Orange County, New York, Webster compiled a spelling-book. This was printed at Hartford the next year and gradually won very wide acceptance. During the twenty years its author was engaged in preparing his dictionary, 1807 to 1827, the profits from that one little school-book furnished the entire support of his family, though his copyright receipts were less than a cent a book. The sales went on increasing up to the time of Mr. Webster's death, at the age of eighty-four. A million copies annually were then being called for, and the total distribution had reached twenty-four millions.

"In his person Webster was tall and slender. To the very end he was remarkably erect, and his step light and elastic. He was enterprising, self-reliant, and very methodical, and a most persevering worker. Besides the monumental labor of making his dictionary, he had much to do with newspapers and magazines, both as editor and contributor, and he wrote a great number of books and pamphlets on literary, historical, medical, religious, scientific, and political subjects, some of which were of very marked value in forming public opinion. He taught school in his early manhood for about ten years, and then, from 1789 to 1793, was a lawyer in Hartford. During other periods he served as an alderman in New Haven, as a judge in one of the Connecticut courts, and as a member of the Massachusetts legislature. His activity was astonishing in amount and variety, and it was unceasing. Mental exertion seemed to be the native element of his soul."

In grading the papers the selection was marked off into 85 facts or details, and each person's grade was determined by adding together the total numbers of facts he recalled in the first and second recalls. Generalizations were fairly common, *e. g.*, he wrote for the newspapers on a number of different subjects. These were allowed 1 point.

### III. REASONING.

In this and the two remaining tests each student had a clear mimeograph copy of the questions before him. In the reasoning exercise the aims were to test the student's sense of the

truth or falsity of ordinary judgments and his sense of the logical connection of statements. No course in logic was presupposed. The meaning of the terms 'premise' and 'conclusion' was explained and the necessity of giving reasons for one's answer in case an error in the reasoning was thought to be detected was emphasized, but otherwise no further directions were given than those which head the exercise. Seventy minutes was allowed.

## A.

State whether the following conclusions are *necessarily* true or not. If not, where is the error? Point it out. If the reasoning is sound, but the premises false, point out what is false in the premises.

1. The express train alone does not stop at this station; and as the last train did not stop, it must have been the express train.

2. If Parr's pills are of any value those who take them will improve in health; my friend who has been taking them has improved in health; therefore they are of value.

3. Nothing that increases taxation can long be popular. All wars increase taxation, and consequently none of them can be popular very long.

4. If he did not steal the goods why did he hide them, as no thief fails to do?

5. The Greek teacher of oratory and politics, Protagoras, makes an agreement with a pupil, Euathlus, by which the latter is to pay for the instruction which he has received from Protagoras, as soon as he wins his first case; but as he engages in no suits, Protagoras gets nothing, and sues him on that account, confronting him with the following dilemma: "Whatever be the issue of this case, you must pay me what I claim; for if you lose you must pay me by order of the court, and if you win you must pay me by our contract." Euathlus retorts as follows: "Whatever be the issue of this case, I shall not pay you what you claim; for if I lose I am free from payment by our contract, and if I win I am free by order of the court."

6. An Athenian mother urged her son not to enter public life on the following grounds: "If you say what is just, men

will hate you; and if you say what is unjust, the Gods will hate you. You must say one or the other; therefore you will be hated." The son replied that he ought to enter public life, giving the following reasons: "If I say what is just the Gods will love me; and if I say what is unjust, men will love me. I must say one or the other; therefore I shall be loved."

7. Giving advice is useless. For either you advise a man what he means to do, in which case the advice is useless; or you advise him what he does not mean to do, and the advice is ineffectual.

B.

Solve the following examples:

1. Twelve persons hired a boat for a certain sum. Four of them withdrew without paying, and thus the expense of each of the others was increased by \$2. What was the rent of the boat?

2. Three men can paint a boat in four days. Two of them can do it in six days. How long would it take the third man working alone?

C.

Prove the following theorems:

1. The diagonals of a rhombus are perpendicular to each other and bisect the angles.

2. Two circles have radii of 8 inches and 3 inches respectively, and the distance between their centers is 15 inches. Find the length of their common tangents.

In grading the reasoning papers no certain amount of credit was allowed for each question. The student's ability was *estimated* as teachers of English estimate a student's ability to use the English language from a written paper. Certain rules regarding doubtful questions, which cannot be given here, were followed. Liberal credit was allowed for partially correct answers or for differing answers, where there was ground for a difference of opinion. The paper gives opportunity for different degrees of ability. In A the first four and the seventh are relatively easy, the sixth more difficult, and the fifth the most difficult. B2 is harder than B1, and C2 than C1. *As the attempt was made to grade the papers only as good, medium and poor*, it is believed that the marks are reliable. Five degrees of ability could prob-

ably have been distinguished, but the more conservative position seemed the wiser under the circumstances.

#### IV. GENERALIZING POWER.

Before beginning this test the meaning of generalizing was explained. This was probably unnecessary as the class had already studied the process during the term. The term 'selectmen' was also explained. Time allowed: 50 minutes.

1. What generalizations can you make from the facts given below? Why is the cloth around the glass *wet*? Why is straw put under the saucers in India?

"Water put into a vessel of unglazed clay is kept permanently cool in warm dry air, by the evaporation from the surface of the vessel. A similar result is produced when a glass vessel is employed, if it be wrapped in a wet cloth and placed in a current of air. In some parts of India ice is procured by exposing water at night in shallow unglazed saucers, laid upon rice-straw. More rapid effects may of course be obtained by using instead of water more highly evaporable liquids, such as sulphuric ether. A few drops of ether sprinkled on the bulb of a thermometer, produce an immediate contraction of the contents, which is greater as the temperature of the air is higher. This process, with a quantity of dry oatmeal, or a large surface of sulphuric acid (to absorb the vapor as it is formed) was employed by Sir John Leslie for the purpose of making ice; and is still, with various modifications, the basis of some of the most convenient domestic ice-machines."

2. What general statement or statements can you make which will be true of all the following instances of the way in which Colonial schoolmasters were paid?

In Watertown, Mass., in 1680 the schoolmaster got 25 pounds and the benefit of the Latin scholars. In Newbury, Mass., in 1696 the schoolmaster was offered 30 pounds in country pay by the selectmen provided he demand but 4 pence per week from Latin scholars, and teach the town's children to read, write and cipher without pay. In Lynn, Mass., in 1702 a schoolmaster was allowed 40 pounds by the selectmen, and Latin pupils were charged 6 pence per week. In this case, assuming an average

of 6 Latin pupils attended the whole year, we see his total wages would be about \$237. In Hartford, Conn., in 1643 the town agreed that the schoolmaster should receive 16 pounds, that this should be raised by tuition fees of 20 shillings a year per pupil as far as possible, but the town was to make good any deficit. The indigent were free. Salem, Mass., had a subscription for its school, but the town provided for the poor by a rate.

3. What is the difference between plants and animals?

4. What is the difference between the two classes of movements referred to in this selection: If wasps are allowed to come into a room for honey placed there, and if after they enter the window is closed and another window on the opposite side of the room is opened and they are put out at this window, after a number of repetitions of the experience they will leave by the latter window of their own accord. Chickens driven into a shed after nightfall for a number of days will finally go there without driving. Contrasted with these movements are the movements of the human eyelids when solid matter threatens to enter the eye, and the trophic movements of plants, such as the turning of their leaves toward the light when placed in a window.

5. What is the difference between gambling and legitimate business investment?

6. What is the difference between courtesy and gallantry?

The estimate plan of grading the papers was used here. The questions *most* relied upon in determining the grades were the first, second and fifth.

#### V. POWER TO UNDERSTAND ABSTRACT THOUGHT.

About 40 minutes was allowed for this test.

Study the selection numbered 1 and tell the meaning of it in your own language. No notice will be taken of papers which quote the selection, even in altered words. Express *all* the ideas that you get from it. Then do the same with the selections numbered 2, 3 and 4.

1. "It has been said that protection is the cause of high wages. Our present tariff averages above forty per cent. on the entire amount of dutiable goods; and as a result the price of all articles named in the schedules, both of foreign and domes-

tic manufacture, is raised in most cases by the entire amount of the tax, since importation continues. Since the list includes nearly every article of comfort or necessity in the family, the laborer must pay a considerable part of his wages to meet this tax. In most cases this increased cost of commodities is far greater than the assumed increase of wages. Hence the laborer is injured, even on the supposition that the claim of protectionists is true. When analyzed, wages are not the dollars received, but the goods which they will buy. Profit is not the money handled, but the sum that is saved."

2. "No one will doubt that men are more possessed by the instinct to fight, to be the winner in serious games and contests, than are women; nor that women are more possessed than men by the instinct to nurse, to care for and fuss over others, to relieve, comfort and console. . . . The fighting instinct is, in fact, the cause of a very large amount of the world's intellectual endeavor. The financier does not think for money, nor the scientist for truth, nor the theologian to save souls. Their intellectual efforts are aimed in great measure to outdo the other man, to subdue nature, to conquer assent. The maternal instinct in its turn is the chief source of woman's superiorities in the moral world. The virtues in which she excels are not so much due to either any general moral superiority or any set of special moral talents as to her original impulse to relieve, comfort and console."

3. By realism we shall mean a belief in the existence of things independent of perceiving minds, and by realism, the contrary belief that nothing exists but minds. The fundamental fallacy of realism lies in its assumption of the existence of primary and secondary qualities in things. By primary qualities they mean those which exist in things independent of the perceiving mind. They are extension in three dimensions, weight, motion and number. By secondary qualities they mean those which are produced by the action of things on our sense organs, such as color, sound, taste, odor, temperature, and so on. But according to this definition of secondary qualities, all the so-called primary qualities are as truly secondary as the secondary ones themselves. For we know nothing of

their existence, except as we get them through our sense organs.

4. "Motives. There is no need of restricting the word motive to any particular class of feelings. Any mental state may serve as a motive. For a motive to an act is simply any fact which assists to be present and to be approved a mental state which will have the act as its sequent. A motive against the act is simply any fact which hinders the presence and approval of a mental state which will have the act as its sequent."

As in the third and fourth tests the estimate plan of grading the papers was followed, and only the three grades of ability good, medium and poor were distinguished. The selections vary a good deal in difficulty thus allowing scope for different degrees of ability. The third is the most difficult. The fourth, taken from the text-books in psychology they were then using, is a passage which they were supposed to have studied but it was omitted in the recitations.

#### RESULTS.

Sixty-three persons completed the five tests properly. Thirty-three more took some of the tests but missed others through absence. The percentages of correlation include the latter. In calculating them the grades—given in the form of the total number of errors in the accuracy test, the sum of the total number of facts remembered in the two recalls in the memory test, and in the form of verbal grades in the three other tests—were all changed into their corresponding values in Galton's table of the normal curve of distribution.<sup>1</sup> The coefficients of correlation were then calculated by the method of unlike signed pairs. They are as shown on next page.

It is needless to say that the figures are much higher than those usually obtained for the simpler mental processes. The next table is a group comparison of the 63 students who completed all five tests. It gives their grade in each test. The subjects are denoted by numbers, and are arranged in three groups with reference to their standing in the reasoning test.

<sup>1</sup> Galton, Francis, *Natural Inheritance*, p. 205. I am indebted to Professor E. L. Thorndike for assistance in figuring the coefficients of correlation.

## COEFFICIENTS OF CORRELATION.

	Per Cent.	No. of Cases.
Reasoning and generalizing . . . . .	95	96
Reasoning and abstract thought . . . . .	83	75
Generalizing and abstract thought . . . . .	86	77
Reasoning and memory . . . . .	40	87
Abstract thought and memory . . . . .	64	71
Generalizing and memory . . . . .	40	90
Reasoning and accuracy . . . . .	45	63
Abstract thought and accuracy . . . . .	48	56
Generalizing and accuracy . . . . .	28	63
Memory and accuracy . . . . .	31	62

In this way their standing in the various tests may be compared. The verbal grade good in accuracy and memory was obtained by averaging the number of goods in the three intellectual tests which gave 30, or 48 per cent. of the 63 persons concerned. The highest 48 per cent. of the memory and of the accuracy grades were then called good. The terms medium and poor were obtained in the same way. Hence in these two tests the terms are not estimates, but derive their meaning from the three other tests. The table may be read thus: Of the 30 persons good in reasoning all are good in generalizing, 25 are good in comprehending abstract thought, 20 are good in memory, and of the 24 persons good in reasoning left after deducting the 6 defective in eyesight, 15 are good in accuracy. Of the remainder more are medium than poor. Of the 17 persons poor in reasoning 12 are poor in generalizing, 13 in abstract thought and 8 in memory, and of the 16 poor in reasoning left after deducting 1 defective in eyesight, 6 are poor in accuracy, etc. We find in this group comparison considerable evidence for the existence of three major types of mind, from the point of view of the traits investigated: First, persons good in the three intellectual traits, secondly, those poor in them, and thirdly those between the two extremes in all three traits. The term type is used to denote stages along a continuous line.

But the types tend to be more comprehensive than that. Persons who are superior in the three intellectual traits are apt to have better memories, and obversely. This is shown both by the group comparison and by the average of 48 per cent. correlation between memory and the intellectual traits. There

is some tendency for even accuracy to vary with the three mentioned (40 per cent. average correlation).

## GROUP COMPARISON.

*Good in Reasoning.*

Subject.	Generalizing.	Abstract Thought.	Memory.	Accuracy.
1	Good <sup>1</sup>	Good	Good	Good <sup>1</sup>
2	"	"	"	"
3	"	"	"	"
4	"	"	"	"
5	"	"	"	"
6	"	"	"	"
7	"	"	"	"
8	"	"	"	"
9	"	"	"	"
10	"	"	"	"
11	"	"	"	"
12	"	"	"	"
13	"	"	"	Medium
14	"	"	"	Poor
15	"	"	"	Medium
16	"	"	"	"
17	"	"	"	Poor
18	"	"	"	" <sup>1</sup>
19	"	"	"	Medium
20	"	"	Medium	Good
21	"	"	"	"
22	"	"	"	"
23	"	"	"	Poor <sup>1</sup>
24	"	"	Poor	Medium <sup>1</sup>
25	"	"	"	Poor <sup>1</sup>
26	"	Medium	"	Medium
27	"	"	Medium	Poor
28	"	Poor	Poor	Medium
29	"	Medium	"	Good <sup>1</sup>
30	"	"	Good	"

*Poor in Reasoning.*

31	Poor	Poor	Poor	Poor
32	"	"	"	"
33	"	"	"	"
34	"	"	"	Medium
35	"	"	"	Good
36	"	"	Medium	"
37	"	"	"	"
38	"	"	"	Poor
39	"	"	Good	Good
40	"	Medium	Poor	Medium <sup>1</sup>
41	Medium	Poor	"	Good
42	Poor	Medium	Medium	Poor
43	Medium	Poor	Poor	Medium
44	"	"	Medium	Good
45	"	"	"	"
46	Poor	Medium	Good	Medium
47	Medium	"	"	Poor

<sup>1</sup> Defective eyesight.

GROUP COMPARISON.—*Continued.**Medium in Reasoning.*

Subject.	Generalizing.	Abstract Thought.	Memory.	Accuracy.
48	Medium	Medium	Good	Poor
49	"	"	"	Medium
50	"	"	"	Good
51	"	"	"	"
52	Good	"	"	Medium
53	"	"	"	Good
54	"	"	Medium	" <sup>1</sup>
55	"	"	Poor	Poor
56	Poor	"	Good	Medium
57	"	"	Medium	Good
58	Medium	Poor	Poor	Poor
59	"	"	Medium	"
60	"	"	Poor	"
61	Poor	"	"	Good
62	Good	Good	Medium	Medium
63	Poor	Poor	Poor	Poor

The group comparison also affords ample evidence for the existence of some minor types often assumed by practical experience. Among these are the bright but careless and the dull but painstaking types. One student whose reasoning and generalizing abilities and power to grasp abstract thought are unquestioned wrote in the accuracy test 'Witner' for Witmer, 'Titchner' for Titchener, 'chapters V. and VII.' for V. and VI., and omitted one line of text resulting in giving a wrong name to a book; and there were many others similar, if less extreme. On the other hand 7 of the 17 poor in the intellectual traits are painstaking enough to rank good in accuracy. Still another pair of minor types are those who in memory rise above or fall below their standing in the intellectual traits.

In accounting for the large percentages of correlation it may be said that the grades in the reasoning, generalizing and abstract thought tests are estimates of one person only, who might have been influenced by a preconceived theory, or by a preconceived opinion of the abilities of the persons tested, inasmuch as they had been in his class for two months. The possibility of this is not denied. The writer was on his guard against it always. The papers were graded by sets of a kind, *e. g.*, accuracy, and not all of the papers of one student at a time. On the other hand the coarseness of the grading in three tests

<sup>1</sup> Defective eyesight.

and the method of calculating the coefficients underestimates the real correlation.

In conclusion the question is pertinent: What abilities have been tested? For the whole tenor of previous investigations has been toward the opinion that there is no such thing as *the* trait accuracy or *the* power to comprehend abstract thought, but on the contrary there are as many kinds of accuracy as there are occupations to be accurate in. A person may have considerable acumen in comprehending the psychological differences of the sexes and their consequences, and very little in grasping the effects of a high tariff on wages. There is however a mass of experiences which may be fairly assumed to be the common possession of all normally constituted persons of eighteen years of age or over who have reached the second year of a normal school course requiring two years of high school work for entrance. In framing the tests the writer endeavored to keep well within these limits, and it is believed with the *possible* exceptions of the questions on the tariff and on evaporation, he was successful. It was not necessary to solve the Protagorean dilemma to secure a grade of good in reasoning. For testing the five abilities (or five kinds of abilities, if they are plural) in this elementary way it is believed that a large number of different materials are equivalent. If a person of the maturity and training described cannot make valid generalizations from the questions about the pay of schoolmasters and the difference between gambling and legitimate business investment, it is safe to say he is deficient in what is ordinarily meant by generalizing, namely picking out elements common to a group. Or again, if there is a memory for dates, another for names, and another for simple commonplace statements, and if it is possible for a person to be good in one and poor in others, it is also possible to regard the sum of them as a unity, and the passage used in the memory test is a fair elementary test of this aggregate of abilities.

But another phase of the question appears. It may be said that the reason why there is so much correlation is that to a large extent they all test the same abilities. The power to understand abstract thought for example may be claimed to be

required in all, accuracy excepted perhaps, and memory certainly enters into all five to some extent. Even if this were true, it would still be possible to isolate a kind of ability by increasing the demands made upon one and lessening the demands made upon the others, and the tests have done this. But the claim is not true to any considerable extent, as examination of the material used in the tests would show. In the memory test the demand made upon the power to grasp abstract thought is so small compared to the tax upon the memory that it may be neglected. The reasoning test makes heavy demands upon two abilities, judgment and syllogistic inference. No generalizing is required, and not much power to follow abstract thought except in the geometry questions, which few persons reached. The generalizing test makes large demands upon the power to abstract elements common to a group and a small demand upon memory. There are some inferences which may occur in the abstract thought test, but the peculiarity of this test is the absence of illustrations. Success or failure in it depends upon one's ability to interpret its generalized phraseology by means of his concrete experiences rather than upon the inferences which may be involved.

To sum up the matter, then, each test involves unquestionably not one but several kinds of abilities, but there is a predominance of one kind in each test, and it is this kind which the test makes a trial of. Nor are the results less useful because of this fact of compositeness. To go beyond this and discover the identical abilities in the various traits, which the correlations lead us to assume the existence of, is outside the limits of our present purpose.

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